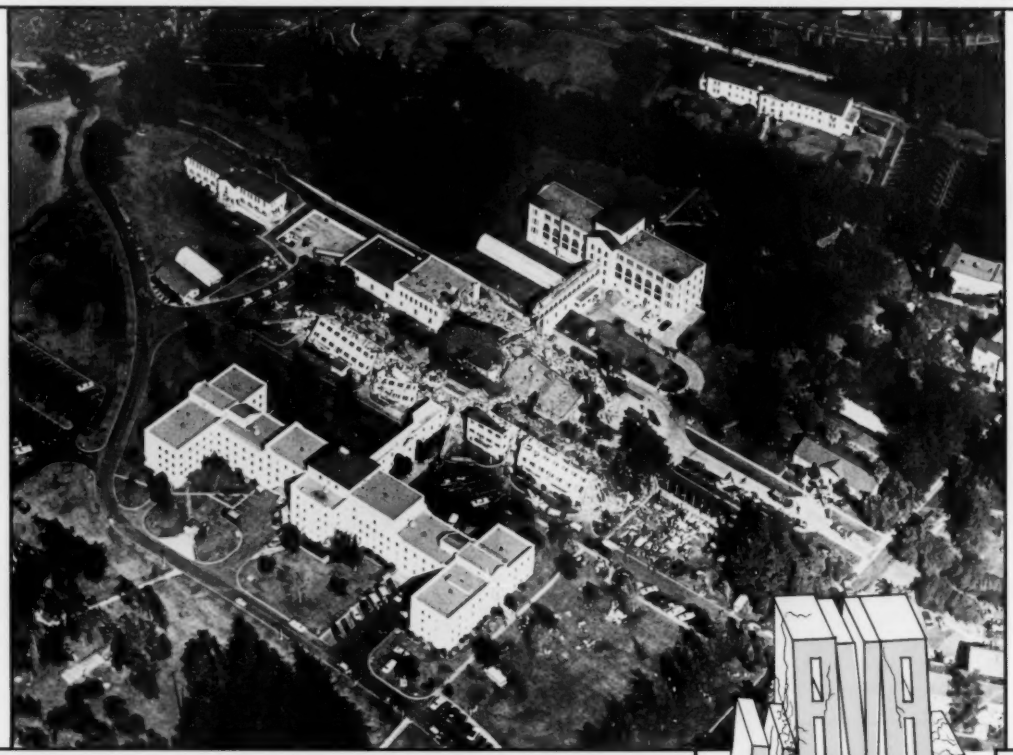
NAVY CIVIL ENGINEER



NAVAL FACILITIES AND THE EARTHQUAKE

No one who has lived through a major earthquake can ever erase from his mind the picture of "terra firma" becoming "terra-quite-infirma," nor can he forget the feeling of total helplessness as the ground pitched and reeled under his feet. It is that helplessness which makes earthquakes so terrifying: most often they strike with no warning and occasionally leave a once familiar world a shattered shambles.

But the engineering discipline, of late, has begun to make headway against the tremendous destructive energy of earthquakes. Newer buildings are designed to resist major earthquake forces.

But buildings which survive earthquakes intact may still be unusable — because the water, gas, electrical, and other service systems are damaged.

To correct this flaw in building design, LCdr David Fluharty suggests a number of design steps be taken. His suggestions are the subject of our lead article this issue. Read what can be done to keep buildings in service after an earthquake — beginning on page 4.

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A. R. MARSCHALL
Rear Admiral, CEC, U.S. Navy
Chief of Civil Engineers
Commander, Naval Facilities
Engineering Command

DONALD G. ISELIN
Rear Admiral, CEC, U.S. Navy
Deputy Chief of Civil Engineers
Vice Commander, Naval Facilities
Engineering Command

HAROLD WELSH
Editor

TOM HARRIS
Associate Editor

BILLYE NEWLEE
Editorial Assistant

BILL BRACK
LTJG JERRY JOHNSON
Contributing Artists

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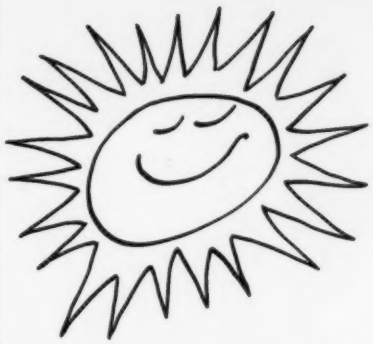
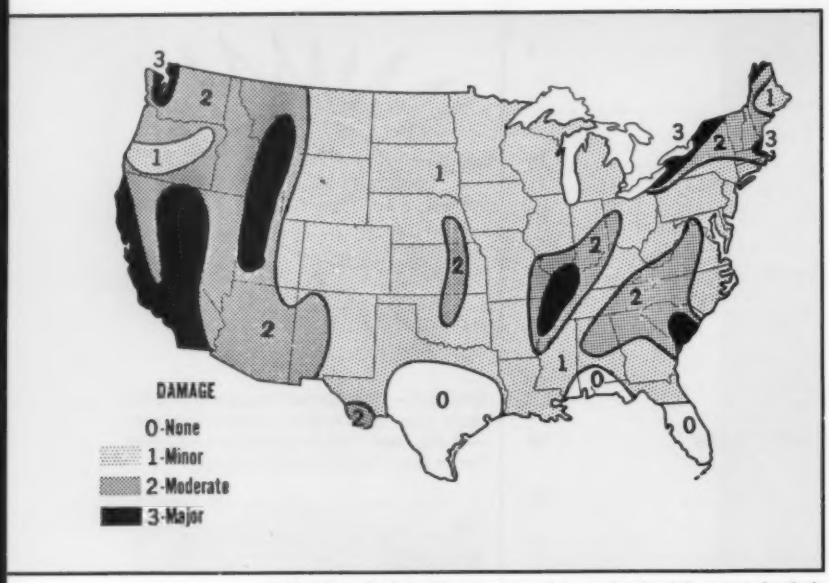


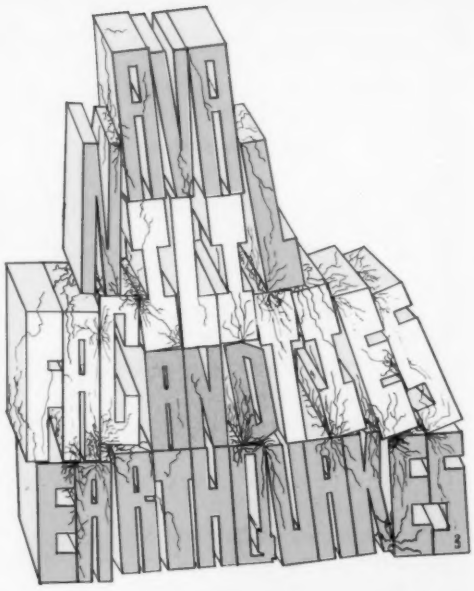
ENERGY — The sun will be putting in a full day's work soon — and at reasonable cost — if the Navy Civil Engineering Laboratory has its way. Read all about it on page 17.

HEALTH — The Navy is investing heavily in new and updated hospitals to assure better health for its men and women. Read all about it on page 26.

BUILDING — The Navy has a new tool for construction: a converted rocket-stage ocean-going barge for building at sea. Read all about it on page 33.

ON THE COVER — A major earthquake shuddered through the San Fernando Valley near Los Angeles, Calif., in 1971, toppling or damaging many buildings. One of the hardest hit was the Veterans Hospital. Damage to the building is evident in the cover photo. Patient care moved to nearby lawns and parking lots (back cover).





ZONES — Architects must consider seismic risk zones in their designs. It would be uneconomical to build a facility in central Texas to resist a major earthquake — and irrational, as well as possibly illegal — to build another in Southern California without considering that possibility.

By LCDR DAVID H. FLUHARTY
CEC, USN

• San Diego, Calif.

It takes but little reflection to conclude that hospitals, fire stations, communications centers, power stations, and emergency facilities must be operational after an earthquake. Yet recent history has shown they are often unusable after an earthquake — when they are most needed.

The Navy needs all these services plus many others essential to military readiness.

The 1971 San Fernando earthquake destroyed two hospitals and left two others with only emergency rooms operating. Fifteen-hundred hospital beds had to be abandoned quickly, and 1,167 patients were evacuated.

All four main hospitals in Managua, Nicaragua, were made unserviceable by the earthquake of December 23, 1972 — a loss of about 650 beds. Temporary facilities were set up on parking lots and lawns there, next to the worthless structures. Fortunately the weather created no hardships.

Recorded history in the United States is very short compared to other seismic regions such as Japan, the Middle East and India. California has the most earthquake activity, even though there have been strong earthquakes in Alaska, South Carolina, Missouri and Montana. (The Missouri earthquakes of 1811 were felt from Canada to the Gulf.)

Population growth and the development of cities is so recent and is occurring so quickly that seismic risk requires continuous appraisal.

Because the laws and practices of California have dominated earthquake engineering in the United States, a short history of design provisions there will provide an understanding of how building codes for all types of buildings developed. As is apparent in the following review, action most frequently is taken in response to a disaster. It should be noted "earthquake resistance" has meant structural resistance, nonstructural elements have received little attention.

Some local provisions were made for extra building strength after the 1906 San Francisco earthquake and the 1925 Santa Barbara earthquake. It was not until the Long Beach earthquake in 1933 that state laws were passed. That earthquake destroyed many buildings including many public schools.

Fortunately, the quake did not occur during school hours, but it did prompt the California State Legislature to adopt the Field Act which assigned several state agencies authority and responsibility to approve plans and supervise construction of all public school buildings.

Also in 1933, the legislature passed the Riley Act which provided some small design force levels. Cities adopted additional lateral forces for design purposes. In December, 1959, the Structural Engineers Association of California (SEAOC) adopted its first Recommended Lateral Force Requirements.

The SEAOC Code has served as the design guideline of structures throughout California and the United States. It has been revised every couple of years but with the same emphasis:

- Resist minor quakes without damage.
- Resist moderate quakes, without structural damage but with some non-structural damage.
- Resist earthquakes of the gravest recorded severity in California without collapse, but with some structural as well as non-structural damage.

The Alaska earthquake of March 27, 1964, caused widespread damage and was investigated by many engineers. However, the nonstructural elements were not thoroughly studied until over two years after the event.

The code changes that resulted from this quake were mainly structural and post-disaster use was still not the basis for those changes. These and earlier codes are the bases for most existing Navy facilities.

Almost seven years after the Alaska earthquake, the consequences of not giving essential faciities special attention were made painfully obvious. On February 9, 1971, the San Fernando earthquake destroyed several buildings and rendered many more unusable because of nonstructural damage. Most structures performed as the codes intended since the codes were concerned with collapse and not with postdisaster use.

In response to that catastrophe, California Senate Bill 519 (SB 519-72) was passed in late 1972. The legislature stated its intent that "Hospitals which house patients having less than a capacity of normally health persons to protect themselves, and which must be completely functional to perform all necessary services to the public after a disaster, shall be designed and constructed to resist insofar as practicable the forces generated by earthquakes, gravity, and winds."

The need for this legislation was confirmed when all four main hospital in Managua were put out of action by the earthquake of December 23, 1972.

From analysis of past construction methods and conditions at existing essential facilities, it can be concluded:

- Many alterations to existing essential facilities will be necessary. Some structural and many nonstructural alterations will be required.
- The cost to make an entire facility earthquake resistant will be high but that the cost need not be to ensure the functioning of many necessary portions of a facility.
- The state of the art of earthquake engineering is advanced enough to define the problems and provide solutions. (Nuclear power plants must withstand an earthquake if only to be able to shut down. The many carefully thought-out and tested provisions for earthquake resistance in these plants gives evidence the engineering knowledge exists to ensure functioning facilities.)
- Since there are many alterations that can be accomplished now, and since there are many critical areas that are unprotected, there is no justification for delay.
- An engineering survey is needed and would be the first step in any corrective course of action.
- An earthquake survey will also allow post-earthquake evaluation of facilities.

What is involved in an engineering survey and analysis? The first step is to determine the probability of seismic activity at a given site. This means a geological survey, often from previous information, about the site's probable seismic activity and it determines the "design earthquake."

The engineering effort should include a complete structural analysis for tall or structurally complex buildings. This requires a dynamic analysis, i.e., mathematically modeling the structure and "shaking" it on a computer using the previously determined "design earthquake."

Dynamic analysis can reveal structural weaknesses needing correction and forecasts the way the structure will act during a quake. The latter defines the forces non-

Shattered — When the 1971 San Fernando earthquake struck, one of the hardest hit facilities was the Veterans' Hospital near Los Angeles. Service at the hospital was halted and patients had to be moved into a parking lot and onto lawns. Modern buildings may resist structural damage but still be unusable because of damage to services.

Wreckage — Clean-up in the wake of an earthquake may hamper — or halt — military operations.

structural elements must resist, including equipment installed by the using agency after construction.

The survey of nonstructural elements must include all utility systems, elevators, emergency power and lighting systems, exits, suspended ceilings, heating and ventilation systems, and storage and operationally related equipment. A plan of action can be prepared based on a definition of problem areas, the estimates of cost, a knowledge of the particular operation and some imagination visualizing post-disaster needs.

The writer surveyed several hospitals and the most critical needs have been easily determined, e.g., freestanding electrical panels, emergency electrical power generators on isolation mountings, utility system valves and entrances to buildings, and medical supply storage.

These are not expensive to correct and will provide protection against both medium and high intensity earthquakes.

Military construction, special projects to the major claimant, funding within local authority, or a combination of these can be used to supply funds. That decision will also be apparent after the survey and analysis and during the planning process.

In September 1973 the California Legislature passed a law with the intent "that emergency service buildings or structures, the collapse or damage of which would preclude or seriously impair services to the public necessary in immediate post-disaster earthquake operations, meet requirements . . . to assure, insofar as practicable, their ability to continue to function after a maximum probable earthquake."

The law defines emergency service buildings or structures and it reads like a description of those functions needed by the Navy to continue military operations: "fire stations, jails (security facilities), those buildings and structures designated by the local jurisdiction as central headquarters for governmental operations during an emergency, and those buildings and structures designated by local jurisdiction to be their central emergency communications center."

The Navy constructs *new* buildings to be earthquake resistant in accordance with *Seismic Design for Buildings*, NAVFAC P-355. It is prepared by engineering firms in California and covers both structural and nonstructural elements provided under the construction contract. However, existing facilities are still vulnerable as is equipment provided outside the construction contract. Recent Navy policy (January and February 1975) increases design forces for "critical buildings" and requires seismic investigations of structures to be updated.

Definitions are not clear and these directives address only a small percentage of the task when considering existing essential facilities.

Surveys are in progress at naval hospitals in Oakland, California, Charleston, South Carolina, and at the Naval Shipyard in Bremerton, Washington. These are important, but very small, steps in the total effort required. Support of the operating forces and their participation in policy decisions are needed for the necessary engineering resouces to be made available and effectively applied.

After the San Fernando 1971 earthquake the Hospital Council of Southern California assessed the disaster and determined which activities caused problems for hospitals. They placed these in order of importance and the top four were: communications, patient emotion, water shortage or contamination, and power and/or fuel. Three of the four can be dealt with by pre-earthquake engineering.

How different emergency response and patient care would have been in San Fernando if those facilities had completed similar alterations in 1970. What about naval shore installations in 1977?

One of the biggest problems after an earthquake is determining whether a facility can safety perform its intended function. The commander must have a professional he can rely on to judge whether all or part of the facility is usable and if it is strong enough to withstand probable aftershocks.

To ensure all facilities needed after a disaster are recognized as usable, a plan has been developed by the writer and Ben Kacyra, Director, Earthquake Engineering Systems, San Francisco. A qualified structural engineer and a supporting team of structural engineers must be available to act immediately after an earthquake.

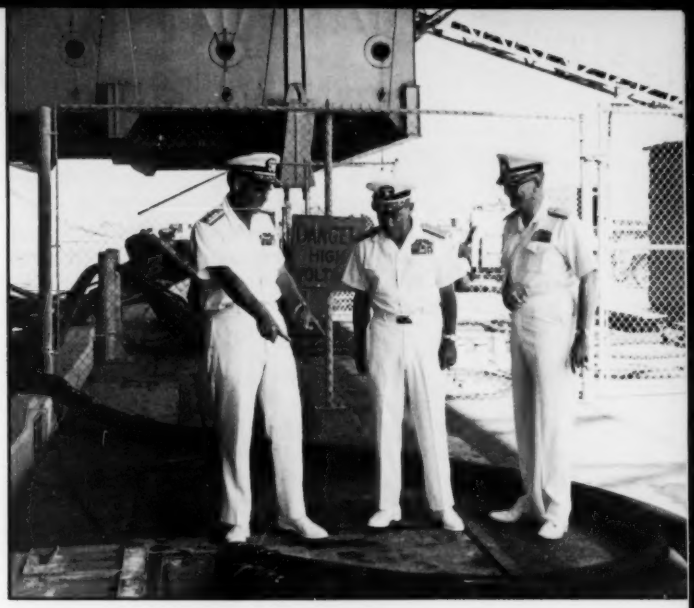
Because of this task's importance, team members must be cross-trained in each other's job. Qualified structural engineers must be available to cover essential facilities in a navy complex. Each complex should have enough engineers to cover all essential facilities in that complex.

One engineer should be assigned to each essential facility. Also, at least three other task force members should be familiar enough with the facility to substitute for the assigned engineer. Familiarity with structural systems and other critical systems is a must for the assigned engineer and stand-by engineers.

The engineer who performs the structural analysis discussed in this article will have defined weaknesses and determined the behavior of the structure during different earthquake loadings. That engineer would then be engaged for that faciity and would lend his knowledge to stand-by engineers.

For new essential facilities, it is best the design engineer be asked to convey his knowledge of the facility to the assigned and stand-by engineers. Thus, each essential facility would have a minimum of four engineers who would be available at a very short notice to make an inspection to determine the necessary measures after an earthquake.

Cleaning Up The Oldest Navy Pollution Problem



CLEAN-UP — Admirals Walton (since retired), Marschall, and Heid — all of NAVFAC — inspect the piping system allowing shipboard wastewater to be transferred ashore for treatment. Inauguration of the wastewater transfer system at Norfolk was a major step toward cleaning up the Navy's oldest pollution problem.

By R. L. LANCASTER
Environmental Engineer

• Norfolk, Va.

Since the Declaration of Independence, United States Navy ships have discharged raw sewage in every corner of the world. On 22 June one giant step was taken toward ending this when the world's largest naval ship, *USS Nimitz* (CVA 68) hooked up to pierside collection facilities at the Naval Station, Norfolk. This was a major milestone in the effort of shore and ship establishments to clean up shipboard pollution.

Naval Facilities Engineering Command, as the Navy's shore pollution abatement manager, is installing pierside collection facilities at Navy ports throughout the United States. Within Atlantic Division's area, $24 million in pierside sewer facilities are programmed, under construction, or completed at Naval Station, Norfolk; Naval Amphibious Base, Little Creek; Naval Weapons Station, Yorktown; U.S. Naval Station, Roosevelt Roads; and the Norfolk Naval Shipyard, Portsmouth.

About 100 ships a year are now outfitted with a Collection, Holding and Transfer (CHT) system. This retrofit will allow shipboard sewage to be collected in holding tanks. Sewage will be retained onboard while ships are within three miles of the coastline. Upon reaching shore facilities, ships will connect sewage hoses and discharge via pier pipelines and pump stations to treatment facilities.

Operation of the system by the Navy Public Works Center, Norfolk, makes Norfolk the largest Navy port complex to use this system routinely. The Navy expects to eliminate all shipboard sewage discharge before the mandatory compliance date of 1983. The Norfolk facility was tested March 8, 1976, when the *USS Yarnell* became the world's first combatant ship to use pierside collection facilities. Since then, facilities have become operational on six Navy piers. The Norfolk system was completed in mid-August. It is expected by the end of 1976 over 30 ships will be using these facilities. Connection from the *Nimitz* is significant because of the magnitude of the problem. She houses over 6,000 people who produce over 300,000 gallons per day of sewage — equivalent to a small city.

Success of the *Nimitz* sewage connection was an example of cooperation between Navy Public Works Center, Norfolk; *USS Nimitz*; COMNAVAIRLANT and LANTDIV typified in the ship-to-shore connections. Both pier and ship connections required making unique elbow connections. The Navy Public Works Center, Norfolk, shops made the fittings used aboard the *Nimitz* and the *Nimitz* shops made the fittings used on the pier.

One potential problem with shipboard sewage is its treatability. Shipboard sewage is salt water borne with chloride concentrations from 4,000 - 9,000 parts per million. This may create significant problems in biological treatment systems designed for fresh water borne sewage. LANTDIV Regional Environmental Support Office is now monitoring the quantity and quality of shipboard sewage to determine its impact on regional biological treatment systems.

This monitoring program will support rate negotiations.

Routine use of the Norfolk pier sewer system is but the first step in a many-mile journey. The Navy's fundamental waterborne existence makes water pollution abatement goals very important. There are still many technical and operational questions to be resolved. However, connection of the *USS Nimitz* marked the beginning of the end of the Navy's oldest and most fundamental pollution problem.

GRADUATE EDUCATION AND THE CEC

Special Training For Those Who Will Hold Special Billets

By LT ROBERT C. PIZZANO, CEC, USN
Assistant for CEC Education and Training
NAVFAC HQ

• Alexandria, Va.

The specialist philosophy in today's Navy is rapidly overtaking that of the generalist. This parallels the trend in private industry. Unlike the private sector, however, the officer corps tends to be a closed system with little lateral input from outside sources and, therefore, rather than hiring officer specialists as needed, the Navy must meet present and future needs in house.

Because of the money spent meeting these needs, there has been a continuing interest in officer education by both Congress and the Department of Defense. The Navy most recently took a close look at officer education programs in 1974 when the Chief of Naval Operations directed the Naval Officer Professional Development Study (Bayne Study).

The result was the current subspecialty system. This system identifies the level of education billets require and specifies officer educational qualifications beyond those inherent in a particular designator. On the basis of billet requirements and the level of education of the officer corps, the system determines training requirements, the assignment of officers to meet requirements and administration of the process to ensure effective management.

In May 1975, the Chief of Naval Operations convened the first Subspecialty Review Board (SRB). The SRB was to identify and justify minimum post-baccalaureate educational requirements for all officer billets. The Chief of Civil Engineers was designated a primary consultant for those billets which require advanced education in facilities engineering (civil, electrical and mechanical engineering), ocean engineering and petroleum engineering.

"... rather than hiring ... specialists ... the Navy must meet ... needs in house."

The SRB identified 695 Civil Engineer Corps (CEC) billets that require advanced education. These billets are indicated in Part III of the Civil Engineer Corps Directory, NAVFAC P-1. There are no billets that require advanced education in more than one field and therefore the Subspecialty System does not provide for dual masters degrees for CEC officers.

The officer and billet subspecialty codes have two subsets. The first two digits indicate the broad application or functional field — such as civil engineering, public affairs, and material support. The second two digits indicate the education or skill field — such as financial management, facilities engineering or petroleum engineering. An alphabetic character is added to indicate the level of education; e.g., P (master's level), D (doctor's level).

Some subspecialty billets represent skill fields unique to the CEC and are coded in the 11XX series. For example, billets which require a master's degree in facilities engineering are coded 1101P. Other subspecialty billets represent skill fields which are common with other designators and are prefixed with 00. Financial management billets are examples and are coded 0031P.

In contrast to the billet codes, all CEC officers who have expertise in any skill field are coded in the 11XX series. For example, officers who attain a master's degree in petroleum engineering or in financial management would receive a subspecialty code of 1102P or 1131P, respectively.

"The subspecialty system is structured to identify and accomplish Navy missions."

It is the responsibility of the Chief of Naval Education and Training (CNET) to provide educational programs to meet identified billet requirements. There are generally two delivery systems for those programs which require postgraduate education — Naval Postgraduate School (NPS), and selected civilian institutions. The Chief of Naval Personnel (CNP), on the other hand, establishes plans — with each Designator Code Sponsor — to assign officers to schools and billets, also considering the factors which affect personnel assignments. CNET assures educational goals are met and CNP assures officer assignments are consistent with requirements.

The subspecialty system is structured to identify and provide officer education levels to accomplish Navy missions. There are two real-world situations, however, limiting the ability of the CEC to meet all requirements. The first is a pure numbers consideration. The CEC requirement of 695 coded billets is nearly 15 percent of total Navy requirements and 50 percent of all CEC billets (effectively increased to 65 percent when WO, LDO, ENS and LTJG billets are excluded).

An annual PG school input of 125 officers is theoretically needed to meet these requirements! There are only 40 training line billets authorized for the CEC. This represents the CEC ability to send officers to PG school without impact on other billets. Sending

more than 40 to school in a year means some other billets must be "gapped" or left vacant temporarily. Historically, PG school input has averaged 62 officers yearly in an effort to increase the number of officers available to fill coded billets. The Chief of Civil Engineers has endorsed this input level.

The second situation that exacerbates the ability to meet all requirements is the fact there have recently been shortfalls of 20 to 40 officers yearly in meeting CEC needs. These shortfalls restrict further increases in the annual PG input since they, too, contribute to billet gapping.

"Historically, PG school input has averaged 62 officers yearly."

Officers are selected for postgraduate school by the annual selection board meeting in August. The CEC program is elaborated by NAVFACNOTE 1520 which outlines available programs and eligibility criteria and provides a preference card. NAVFAC's Assistant for CEC Education and Training receives completed preference cards and forwards the "tear strip" at the bottom to BUPERS to be entered in the officer's master file (ODC).

This file is the source for a listing of those officers who will be viewed by the selection board. The list is verified by name and curriculum by the Assistant for CEC Education and Training who also screens each applicant's record to ensure a complete and legible transcript is on file. The transcript is important since it is the basis for establishing undergraduate academic performance and potential for graduate education.

The selection board has subpanels for each officer designator group, e.g., 11XX, 3100, 5100, etc. The CEC subpanel has two senior CEC officers who make all CEC selections. There are two basic criteria for selection — academic excellence and professional performance. Generally, the greater emphasis is on performance. In the selection process, officers are first viewed for their primary choice for selection as a principal or an alternate. Each curriculum has a selection ceiling. Officers who are not selected within this ceiling for their first choice are subsequently viewed for follow-on choices.

"Recruiting shortfalls restrict further increases in the annual PG input."

Upon approval of the board results, each CEC selectee receives a selection notification letter which also indicates probable school assignment date. This school assignment date is determined on the basis of officer availability (projected rotation date), selection status (principal or alternate) and quotas available. Quota availability is provided by BUPERS and is determined by considering training billets authorized, training shortfalls, current quotas filled in school, and community capability to send additional officers to school.

It is BUPERS policy to extend officers to meet input dates. Officers are not short-toured to meet input dates. Generally, principals are ordered to school at their first rotation after selection. Alternates are ordered to school as quotas become available. At present, it appears most alternates will be sent to school. Principals and alternates selected but not available to attend school retain their eligibility and are banked for up to three fiscal years.

These officers are not screened again by a PG board except on two occasions. First, if any officer changes preference, he or she, in effect, begins the selection process again with the next selection board. Second, in accordance with policy established by OPNAVNOTE 1520, all officers who have been banked for two years and not yet under orders to PG school when the board convenes are screened. The purposes of this screen/reselection are to establish a new bank period in the event an officer cannot be sent to school during the remaining year of bank status, and to assess current qualifications for selection in terms of performance since the initial selection.

Orders are issued four to five months in advance of class convening. Normally, all officers entering civil, electrical, mechanical, ocean and petroleum engineering curricula are ordered to school for 12 calendar months. Navy financial management selectees are initially toured for 18 months. This tour may be shortened for officers who have previously completed and can validate some prerequisite courses. A firm tour length is established after the first quarter of school.

"Utilization of the graduate officer is necessary to obtain a return on the investment."

An officer attending a civilian school is required to submit an Education Plan Sheet (EPS) to CNET. The EPS lists by course title, credit hours and semester the education program being pursued. CNET reviews and approves EPS based on Education Skill Requirements (ESR) to ensure education objectives are being met. The ESR identifies specific skills an officer should have after completing education at a given level in a given field.

Graduation is not the end of the continuing process of the Subspecialty System. Utilization is a key word. Utilization of the graduate officer is necessary to obtain a return on the investment of time and money by filling the coded billet requirements. The detailers give utilization and billet requirements due consideration in making assignments.

The goal is to assign an officer the first utilization tour within two assignments after completing school and to have a career utilization of at least two tours. The subspecialty system in operation meets Navy and CEC requirements as well as officer personal professional objectives economically and efficiently.

• Port Hueneme, Calif.

Trash is becoming a 'burning' issue...

To burn or not to burn?

That is the question asked of the 10,000 employees and base residents of the Naval Construction Battalion Center, Port Hueneme, Calif., in August. Military and civilian personnel have been asked to volunteer for a seemingly simple but important chore — putting out the trash not once but twice.

Their cooperation is being sought in a four-month test involving trash collection and disposal. Participants in this experiment will be asked to separate their trash into two piles. Burnable materials (paper, plastic and cardboard) will go into one container and all other solid wastes will go into a second receptacle.

The goal is to collect sufficient combustible trash and convert the heat into a steam generating energy source. If successful, this bonus energy source would conserve existing fuels which are becoming more costly.

The test will determine if separation of trash in the kitchen, office, and shop — officially known as source segregation — is indeed practical, workable and economical.

Officials of the Civil Engineering Laboratory (CEL), in charge of the experiment, said the trash generated at Navy bases is approximately 80% (by volume) burnable. This makes waste a good energy source. Dr. Carter Ward, research mechanical engineer at the laboratory, is coordinating the test.

Results of the Port Hueneme test will be carefully evaluated by Navy officials across the country. Costs of handling and disposing of solid wastes keep rising. The increases are caused by stricter anti-pollution regulations (no outdoor incinerator burning), higher labor costs, and more expensive equipment. The Navy has set a high priority on development of improved methods and equipment to collect, separate, recover and dispose of waste materials at the lowest possible cost.

CEL prefers the trash separation process to be tested on a volunteer basis at the Seabee base rather than approaches advocated elsewhere. Dr. Ward said one system calls for all waste to be dumped into a giant shredder after which non-burnable materials are removed before burning. This is an expensive method requiring a large capital investment in shredding machinery.

The other approach is to burn all solid waste collected and recover the recyclable materials from the ash, Dr. Ward said. This method requires a large and expensive incinerator and, Ward contends, an element of danger. He said materials in the solid waste flow, such as poisons and volatile materials, could cause great harm to incinerator operators and personnel in the area as well as add harmful pollutants into the air.

...and systems for handling waste are fast becoming 'hot' items!

By WILLIAM E. GOODE
NAVFAC HQ
and
KARL E. KNEELING
NESO Environmental Services Division

A guide to recovery and reuse of refuse resources (called the R⁴ guide) is being completed by the Naval Environmental Protection Support Service (NEPSS). The terms "refuse" and "R⁴" apply to all solid waste normally buried in landfills or disposed of without economic return to the Navy.

DoD passed the first draft of the R⁴ guide to EPA as an example of a practical, productive approach to resource recovery.

The R⁴ survey will be managed by Regional Environmental Support Offices (RESOs) at the six Engineering Field Divisions.

The R⁴ guide is the Navy's first attempt to alter the common attitude that base trash handling and disposal are two of the most unpleasant, unrewarding public works jobs. The material and fuel value of this refuse has steadily risen to the point where, at many installations, refuse can indeed be considered a resource.

Recovery and sale of high quality paper stock and metal cans can produce income. For participating activities, Congress permits some of this income to be spent upgrading the base. As energy, Navy refuse can produce up to 15 percent of total Navy shore establishment needs (as does the refuse fired boiler at PWC, Norfolk, Virginia).

Unlike coal or oil, this refuse fuel can be a guaranteed, low cost, low sulfur fuel supply. Recovery and reuse of this resource is to become a central element in Navy solid waste management.

The R⁴ guide is designed to involve activities in the decision

making role of developing R⁴ systems by:

- Guiding the activity through needed surveys.
- Presenting information on available R⁴ alternatives.
- Helping an activity evaluate options.

The R⁴ system development in this guide evolved in 1974/75 when ten naval installations were studied under a NAVFAC contract on solid waste management practices. It is an empirical method which can and should be corroborated with a theoretical method based on generation rates per capita or per square foot of building space.

During these studies, it was found base refuse tonnage was usually below recent estimates; in some cases, an accurate two week weighing program revealed tonnages as low as 35 percent of estimates.

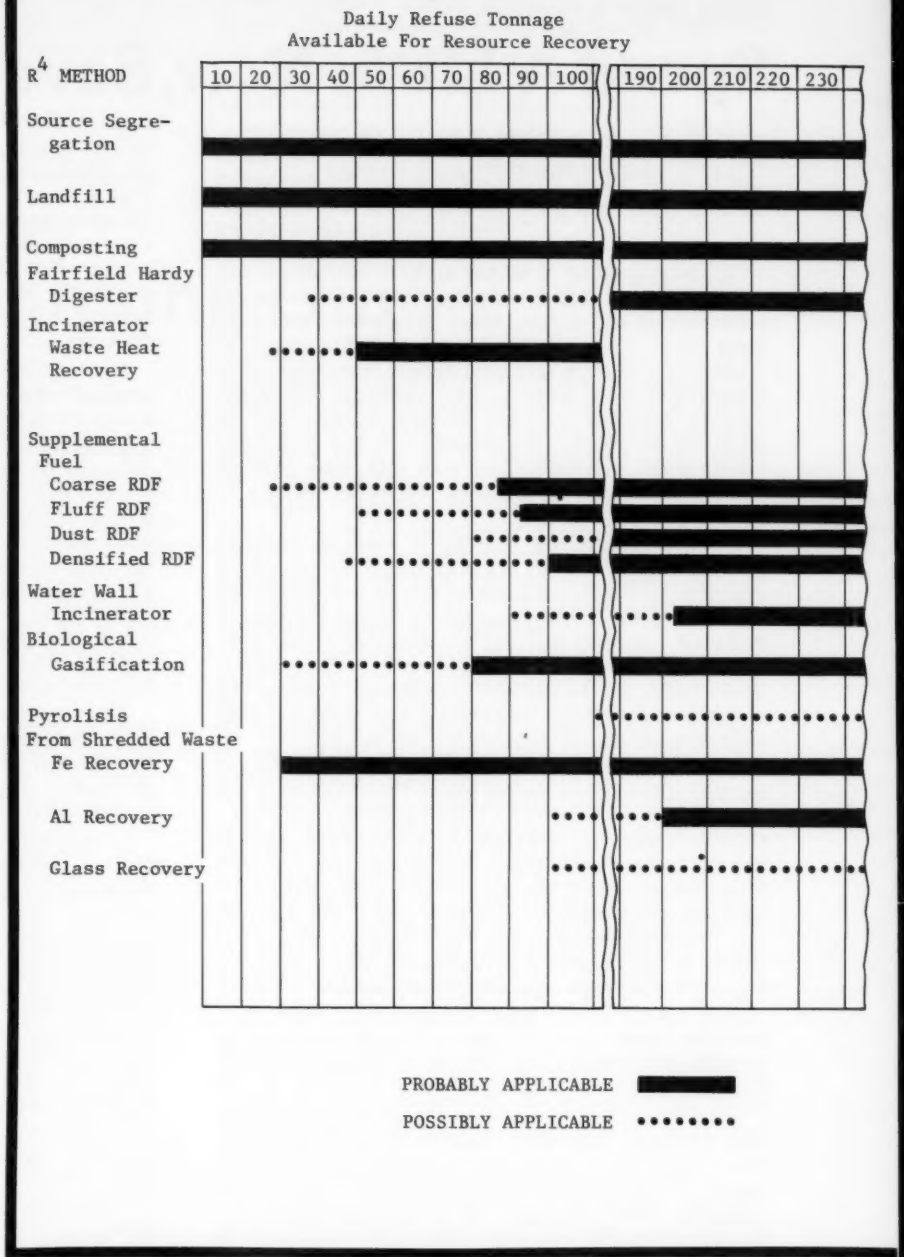
The exaggerated base estimates probably result from volume calculations based on full dumpsters and trucks and a too-high weight per cubic yard factor. Recent studies show the average weight per cubic yard of military refuse to be 84 pounds. This is less than half the average weight of municipal-type refuse.

Using the exaggerated estimate would lead to an obvious miscalculation of resource recovery potential.

Therefore, in considering development of R⁴ systems, particularly those which are capital intensive, an accurate characterization of base refuse is most important. The only means of doing this is to get a handle on the type and volume of refuse through on-site surveys.

The survey should have one, and possibly two phases. The second phase will be needed if it is shown there is economic potential for a capital intensive R⁴ system. Central to both phases are accurate recordings of the type and volume of refuse. A second goal is to provide information to manage solid waste collection and disposal resources effectively.

The next step involves fitting survey information to proven, off-the-shelf R⁴ modules ranging from low-cost baling of quality paper stock to refuse fuel processes costing several million dollars.



R⁴ systems are built from one or more modules described in the R⁴ guide. Modules are geared to fit the refuse tonnage of typical military bases.

The third step begins with selection of alternative systems for economic analysis. These will be evaluated on a ten year cost basis against the costs of current disposal practices. As all solid waste handling and disposal practices can contribute to both air and water pollution, it is necessary to provide for compliance with applicable pollution control regulations in the economic analysis.

The final report containing survey data, R⁴ options, and economic analysis is then used by the activity to select appropriate projects for development.

Utility Pole Maintenance

Spend A Little Now, Save A Lot Later!

By HARVEY A. SCHULTZ
Applied Biology Program Manager
NorthDiv, NAVFAC

• Philadelphia, Pa.

The Navy method of managing its 1,500,000 wooden utility poles has traditionally been to buy preservative-treated poles and replace them upon failure (some 25 years later). Since purchase and installation cost $150 immediately after WW2, this seemed reasonable. Pole replacement costs, however, have increased drastically. Typical NorthDiv activities estimate it costs $490 to replace a 40 foot distribution pole with two crossarms. Larger poles, especially those with with many lines or transformers, may cost several thousand dollars to replace.

On-site checks by NorthDiv Applied Biology personnel indicate that Navy activities are currently experiencing a pole replacement rate of 3-5 percent per year and more. Utility companies consider losses in excess of 1 percent per year unacceptable. These deficiences are finally being recognized and documented. These losses can be deferred indefinitely, however, by in-place maintenance technology now used by most utility companies.

based on two simple but sometimes misunderstood truths: "There is no natural aging factor affecting the strength of wood poles," (NAVDOCKS MO-200, Electric Power Distribution Systems Maintenance); and "Decay of treated poles and eventual failure results from various causes, but mainly from gradual deterioration caused by fungi . . . in most cases, the decay of . . . treated poles will be just below the groundline . . ." (Rural Electrification Administration Bulletin 161-4, Oct. 1974, Pole Inspection and Maintenance).

This means utility pole failure is not inevitable. Wooden poles can be protected indefinitely from biological deterioration. There are 1,000-year-old wooden temples still standing in Japan.

Since 80% of all losses occur at or just below groundline, it follows this region should get most attention. Protecting poles in-place from groundline decay is simple. Soil is excavated to a depth of 18". The pole is sounded with a hammer by a trained inspector. Suspected internal voids are confirmed by drilling and are then filled with an approved liquid preservative. All external decay is removed with a chipping tool. Preservative gel is applied with a brush and a waterproof wrapping is applied. The pole is then backfilled and tagged. U.S. Forest Service studies prove that poles so treated will be free from decay for 10 years, at which time the cycle can be repeated.

Why do creosoted poles fail in the first place? According to Bell Systems Monograph 3718, "Given a decay threshold value of 5.5 pounds of new creosote per cubic foot of wood . . . half of the poles set before the late '50s contained marginal or below-marginal amounts of preservative. These poles look just as black as the good ones, but they fail early." A batch of southern pine poles treated to an average of eight pounds creosote retention per cubic foot in 1955 actually contained individual poles that accepted as little as two pounds or as much as 14 pounds per cubic foot. Since the decay threshold value is 5.5 pounds per cubic foot, some poles failed in a few years, while others may be sound after 40 years. Even "superstar" poles will eventually become susceptible to groundline decay, though, as volatile preservatives such as creosote finally dissipate.

A comparison of the "replacement upon failure method" with the "in-place groundline treatment method" (favored by the utility companies) was presented to the Edison Electric Institute by private industry at an October 1975 meeting. The study compared total costs after thirty years and included 10 percent compound interest and assumed straight line depreciation. The net savings per in-place groundline treated pole after 30 years was $2,923.55 for an average distribution pole and $8,596.01 for an average transmission pole. Applying the standard formula for the present worth of a future savings, the equivalent uniform annual savings per pole was $17.75 for a distribution pole and $52.19 for a transmission pole.

What are the costs of utility pole maintenance? Large pole plants can be inspected and groundline treated, by contract, for about $10 a pole (every 10 years) and reinforced, if required, for less than $125 each. These are some of the best buys in the maintenance field.

A 1975 below-ground inspection of 10,000 creosoted, but not in-place treated, southern pine poles of all ages belonging to utility companies in the Northern states indicated that 30.1 percent were decayed below the ground. Thirteen percent of these poles were rejects needing immediate attention. Since this sample was identical to a typical Navy pole plant, there is no reason to believe the Navy's poles are in any better condition. Consider too, that if the average failure occurs in 25 years and that if vast numbers of marginally-treated poles were installed in the 1940s great numbers of poles are currently passing below the decay threshold. The alternatives are a modest investment now to extend the life of these poles or to accept large costs in a few years to replace failing poles.

The consequences of failing to act are steadily increasing pole replacement rates, power and communications outages affecting vital defense missions, hazardous climbing for linemen, and disruptive unscheduled replacements requiring overtime funding. No utility company in the country could risk operating this way and neither can the Navy.

A Utility Pole Maintenance workshop was held in Washington, D.C. for NAVFAC biologists Oct. 23-24, 1975, (in conjunction with the NAVFAC Environmental Conference and Applied Biology Program Managers Workshop) featuring guest speakers from REA, and the pole treating and pole maintenance industries. The program included pole maintenance economics, including in-house versus contractual considerations.

The course ended with a field demonstration of

current in-place pole treatment methods. Perhaps it was prophetic that several seemingly sound poles selected at random in a Navy housing area for the demonstration were found to be dangerously damaged below ground by fungus and termites!

Since the course, the new program has expanded further. SouthDiv sponsored a utility pole maintenance workshop and demonstration Feb. 4, 1976, at NAS Jacksonville, Fla. The workshop was attended by two dozen SouthDiv activity personnel including Public Works Officers and Maintenance Control directors.

NorthDiv Applied Biologists are tranined and available to evaluate the condition of utility poles on-site and recommend action to correct any problem.

Progressive maintenance programs can significantly extend the life of the Navy's wooden utility poles. The critical nature and enormous replacement costs of this resource demands prompt attention to be given to these requirements.

Facilities Planning Guide: Nuts & Bolts To Advanced Bases

By R. S. SOLURI
Advanced Base Functional Components Branch
NAVFAC HQ

• Alexandria, Va.

The burden for planning, procurement, assembly and shipping of material and equipment to meet contingency construction needs is greatly lessened because of the application and update of knowledge gained in WW2 and later conflicts. By the end of WW2, planning and construction of advanced bases was moving at a pace undreamed of before the war. By the end of the Korean conflict, more than 700 large and small advanced bases had been built, manned, and put into full operation.

Out of this came the realization that even so large and complex an undertaking as a naval base could be planned, assembled, shipped and built in modules or basic functional components. The Navy's backlog of wartime experience allowed analysis of any given assignment in terms of these building blocks of base construction. Thus the Advanced Base Functional Component (ABFC) System emerged during WW2 and remained largely unchanged thru the Vietnam conflict.

Chief of Naval Material emphasis on a viable planning system dictated a complete ABFC Program update. Lessons learned from Vietnam required a new format for submitting construction requirements in support of contingency plans. Together, these needs produced the NAVFAC Facilities Planning Guide, the basic document identifying structures and supporting utilities of the ABFC System.

The Facilities Planning Guide (FPG) was developed by the Civil Engineering Support Office (CESO), Port Hueneme, Calif., NAVFAC's advanced base facilities design agent, and is published in two volumes. Volumes I and II replace NAVFAC P-140, *Advanced Base Drawings,* and P-103, *Detailed Catalog of Equipment and Construction Material Requirements for Advanced Base Functional Components,* respectively.

The new idea in the FPG and the major change from P-103 is that the facility concept has been introduced, thus allowing a contingency planner to identify by DOD category code, the construction items necessary to develop facilities in support of requirements. Both Volumes I and II of The Facilities Planning Guide are divided into three major sections: Components, Facilities, and Assemblies.

The Components section contains a complete list of facilities by category code that make up a particular component. The Facilities section contains a complete list of items or assemblies which make up any one of the facilities in the Components section. The Assembly section then provides the nuts and bolts materials breakdown for any one of the assemblies shown under the Facilities section.

Volume I contains reproducible drawings with site plans indexed by component designation in Part I; facility drawings indexed by facility number in Part II; and assembly drawings, indexed by assembly number, in Part III. Volume II is the data display for each component, facility and assembly.

Part I quantifies and describes by DOD category code, the facility requirements for each component. Part II quantifies and describes by assembly number, the assembly requirements for each facility, and Part III quantifies line item requirements by naval serial number for each assembly.

Volume II is the primary planning document used in identifying the specific facility, either at the component level or the facility category code level, and provides the appropriate cost, weight, cube, quantity/capacity and construction effort. The facility and assembly drawings of Volume I are detailed construction drawings, not definitives, and the material lists in Volume II are complete bills of material except for earthwork.

With the advent of the Facilities Planning Guide, facility construction requirements in support of Base Development Plans and other DOD planning systems can be called out by category code independently of the ABFC System where it is not needed. The Base Development Plan, one of the appendices to the logistics annex of an Operation Plan (OPLAN) is developed to respond to various possible contingency situations.

In the Navy's case, advanced base facility planners in the Atlantic and Pacific Field Divisions of NAVFAC assist the fleets in preparing the facilities portions of these plans. The Facility Planning Guide is then used by base development planners in the selection of components and facility construction packages needed to support possible contingencies at overseas bases.

The new Facility Planning Guide is, therefore, a valuable tool in planning for that portion of the logistic support related to facilities needed by the Navy to maintain readiness to respond to contingency situations. Additionally, while the Facilities Planning Guide relates primarily to expected needs in contingency situations, its use to satisfy interim peacetime planning requirements, both overseas and in CONUS, would be appropriate.

PWDMS—A New Management System For Public Works

By MILES D. GRAY
Industrial Engineering Branch, NAVFAC HQ
• Alexandria, Va.

The acronym PWDMS has been bouncing off walls lately through Public Works Departments. What is PWDMS? Simply stated it is the Public Works Department Management System.

It has been under development since 1970. The natural question would follow — When will it be completed and available? That is easy to answer, but the answer would create myriad questions at this point.

Let me start by saying that Public Works is a Command responsibility at Naval Shore Activities. Naval Facilities Engineering Command (NAVFAC) is responsible for providing Public Works technical advice and guidance to standardize Public Works management navywide. PWDMS is a set of management specifications developed in concert with NAVFAC MO-321, MO-322 and NAVDOCKS P-318 and is intended as a guide to establish uniform procedures for management and management information systems.

Because of the differently sized, tasked, financed and equipped Public Works Departments (PWDs), a generalized management information system would be required. In 1970 work was in full swing on PWDMS, but the field activities involved had some unique qualities not readily apparent; the system included these qualities.

Another major problem was the proliferation of Automated Data Processing (ADP) equipment available to the PWDs through their major claimants. NAVFAC chose to provide and maintain the ADP programs for use on IBM 360/370 computers and maintain standard management and ADP documentation. The computer programs developed in the early 1970s on Honeywell ADP equipment were assigned to the Civil Engineering Support Office (CESO) and the Facilities Systems Office (FACSO) for conversion and generalization for use on the IBM 360/370.

Importantly, the objective of PWDMS is to design and maintain a uniform public works department management information system. Additionally, it had to:

- Provide field activities with necessary public works management information.
- Be designed *"modularly"* with each module a separate functional system optional to users for either manual or machine use with standard data elements.
- Maximize use of ADP equipment, where economically feasible.
- Minimize input/output documents.
- Use as a design base, the existing Public Works Management Systems.
- Standardize documentation, both functional user and ADP specifications.

What does PWDMS consist of and what does it do? O.K.! PWDMS consists of emergency/service; continuous inspection; preventive maintenance inspection; control inspection; work input control scheduling; management analysis; transportation; utilities.

EMERGENCY/SERVICE MODULE

The emergency/service (E/S) module provides for managing emergency/service work and identification of the magnitude of E/S work in terms of manpower requirements, craft, or work performed, and response time to provide the support. The E/S module identifies equipment and facilities needing excessive E/S support, as well as E/S items awaiting material.

It provides performance evaluation compared to Engineered Performance Standards (EPS) and specific response criteria; produces a three part E/S Outstanding Work Order Listing identifying items awaiting material; produces a three part E/S Completed Work Order Listing with a management analysis and an E/S Facility Listing.

The E/S module has been tested and is operational now at several field activities. The official functional user documentation for E/S (NAVFAC P-428) is in publication and was to be available navywide before the end of FY76. The work force at the activities where E/S is operational is from 100 to 450 personnel.

The data savings have not been quantified in terms of dollars and manpower reductions; however, the number of E/S Work Authorizations in backlog has been reduced by more than 80% and the average age of an E/S Work Authorization has been reduced by more than 50%. NAVFAC is now trying to determine the smallest Public Works activity that can cost-effectively use the E/S module in a machine mode.

CONTINUOUS INSPECTION MODULE

This module has two subsystems: control inspection and preventive maintenance inspection.

The *control inspection system* is used on a periodic basis to identify deficiencies in all facilities and equipment, and to start corrective action to maintain facilities and equipment at required levels. It provides uniform operating procedures, source input documents and output management reports for planning, accomplishing and appraising control inspection; identifies and screens inspection requirements, establishes a plan for controlling and scheduling inspections, as well as monitoring planned inspection performance.

It produces a Control Inspection Reference List, Notice of Scheduled Control Inspections, Control Inspection Schedule, Control Inspection Work Order List and Control Inspection Accomplishment Report.

The *preventive maintenance inspection system*

provides low cost periodic examination, lubrication, minor adjustment, and repair of dynamic equipment to keep it at peak efficiency based on the required level of maintenance. It provides uniform procedures as well as identifying and screening inspection requirements, establishes a plan for controlling and scheduling inspections, and monitors planned inspection performance.

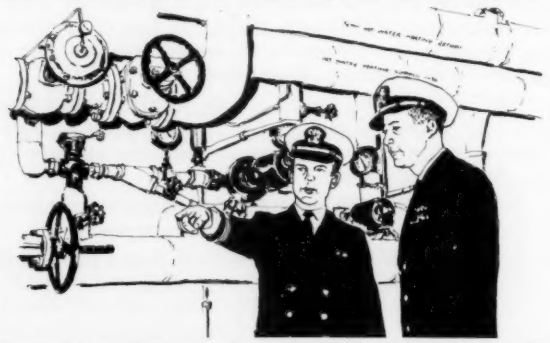
It produces a Preventive Maintenance Inspection Master Inventory, Preventive Maintenance Inspection Schedule, Preventive Maintenance Work Order (with instructions for the worker to accomplish), Preventive Maintenance Omitted Inspections and a Preventive Maintenance Inspection Performance report.

The continuous inspection module is in final stages of debugging on the IBM 360/370 by CESO/FACSO and is targeted for navywide export early in FY77.

WORK INPUT CONTROL MODULE

This module is designed for controlling Public Works Department real property maintenance activities from inception to completion. Scheduling is a subsystem but can be thought of as a separate module.

The work input control module provides functional user documentation for screening and validating work



requests and inspection reports, determining the relative urgency and establishing priorities for accomplishment; establishing an accomplishment plan and controls for plan execution; functional user documentation for backlog of work identification, work status, balancing work load, shop and job performance, and records of facilities history data.

It produces a Status and Planning Report, Minor Work Listings, Manpower Availability Summary, Work Authorization Transactions List and Scheduling Performance Report.

The scheduling system automatically processes data for work force plans/schedules for standing job orders, and specific job orders (over sixty hours) arranged in a realistic and workable priority within constraints of manpower and material availability.

It produces a Shopload Plan by divisions and by shop.

The work input control module is targeted for navywide export in the middle of FY77.

MANAGEMENT ANALYSIS MODULE

This module provides analysis of after-the-fact data reported on completed jobs and work force utilization. It will allow the manager to reduce record keeping and promote management-by-exception. It produces a Completed Work Authorization Report (consolidated), a Completed Work Authorization Report by: Work Center and Cost Center, a listing of jobs on hold, Unfunded Deficiencies, a Maintenance/Utilities Labor Control Report, a Report on Variations including completed jobs (manual) and Public Works Management Control Indices (manual/machine). It is targeted for navywide export late in FY78.

TRANSPORTATION MODULE

This module incorporates data to give management tools necessary to manage efficiently the transportation operation using cost and manhour information directly from the activity financial system. It provides a Transportation Equipment Utilization Report, a Transportation Maintenance and Operation Cost Report, a Direct and Indirect Labor and Material Report by Sub-cost Center, an Equipment Down-time Report, an Accident Cost Report, a Fuel Usage Report, a Work Center Productivity Report, an Actual Manhours versus Maintenance Standards Report, a Transportation Equipment Master Inventory, an Operation Licensing and Testing Report, and a Material Status Report.

This module is targeted for navywide export in FY77.

UTILITIES MODULE

The utilities module incorporates data to give management tools necessary to manage effectively the utility plants and systems at an activity. It consists of three subsystems:

- The Data Subsystem provides information on the performance and condition of the utility system.
- The Target Subsystem provides information on the effectiveness of service utilization and operation efficiency.
- The Allocation Subsystem provides information on the extent a particular utility service has been used by consumers.

The *data subsystem* produces a Utilities Cost Analysis Report, a DOD Installations and Logistics Report and a Management Indices Report. Planned future reports will concern Resources, Replacement, Planning and Energy Conservation.

The *target subsystem* produces Performance Indicator Reports on Heat and Electricity. Planned future reports will include air conditioning and water.

The *allocation subsystem* produces a Billing Report on Quantity of Heat by Cost Center and a Billing Report on Quantity of Electricity by Cost Center. Planned future reports will include billings for air conditioning and water.

It is targeted for navywide export by mid FY78.

IMPLEMENTATION PHILOSOPHY

The philosophy of implementation is that of a "planned staggered phase" for each module. The time frame between implementing modules becomes unquestionably important when you review PWDMS. It can be seen with just the Emergency/Service Module

(Cont'd from page 15)

to worry about it would be relatively simple to implement. After a given time — the "new E/S system" works smoothly and is "old hat" or "part of the family."

The people involved do certain things subconsciously that caused considerable thought earlier.

Once a module is started independently and in operation long enough, it becomes an "old" system, but a foundation on which to build. Then another single module is started and the cycle repeats itself.

Of course each activity has an option on what module or modules it may deem most desirable to implement, either manual or machine. This will depend on the activity, the kind of ADP support available (in-house or commercial), and the benefits, both tangible and intangible, the activity will accept in cost tradeoffs.

It is believed in most cases the benefits of using the computer will be cost effective to the Public Works activity. However, in other cases the cost tradeoff may be neutral or slightly negative, but the information readily received will offset these costs in better management of public works functions.

Differently sized PWDs were mentioned earlier in this article. Therefore, larger PWDs may wish to incorporate PWDMS entirely, medium sized PWDs may wish to incorporate part or all of PWDMS, and smaller PWDs may incorporate only one or two modules.

In any case, should an activity implement and operate a PWDMS module and find its cost effectiveness unacceptable, then the module should be discontinued and the activity's Major Claimant and Engineering Field Division should be informed of the reasons in writing.

The activity's total population, Public Works size, plant value and mission should be included to give NAVFAC sufficient data to determine what future plans must be taken to correct and improve the module for universal use.

Architectural Registration Credit

By PETER BUYNAK
Architectural Division
NAVFAC HQ
• Alexandria, Va.

The National Council of Architectural Registration Boards (NCARB) has delineated the current application of NCARB rules concerning military experience acceptable and creditable towards admission to architectural registration examinations and the NCARB certification.

Military experience will be considered under either category F-12 or F-13 as described in Appendix "A" to NCARB Circular of Information No. 1, released July, 1975. Under F-12, 50% credit is allowed for experience with a maximum credit of two years (four years work). Under F-13 (a), 100% credit is allowed with no limit on credit if the person is in a position directly related to architectural practice equivalent to that of a private architectural firm and in a recognized training program. Only two years credit is allowed under F-13 (b) if the person is not so involved.

For unlimited credit under F-13 (a), the military experience must be obtained in a recognized training program that is diversified and comparable to employment in the office of a registered architect practicing as a principal. Such work must be directly related to architectural work as normally experienced in a private architectural firm, that is, designing, working drawings, specifications, project administration and management, field inspection and supervision; and the work must be done under the direct supervision of a registered architect employed in a capacity of manager of that division (department or section).

Under F-12, persons involved in engineering, contracting, interior design, landscape architecture, planning, and in areas related to construction receive credit for such experience at 50% rate with a maximum allowable credit of two years (four years actual experience).

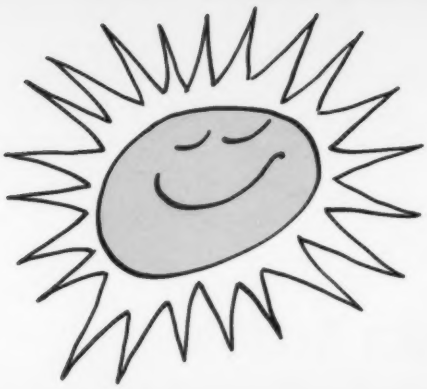
When the two-year maximum credit is obtained under the restrictions of F-12 or F-13 (b), one year of additional experience in the office of a registered architect who is practicing as a principal is required.

CEC officers who have a degree in architecture and who wish to establish eligibility for admission to registration examinations based on military experience should take the following actions:

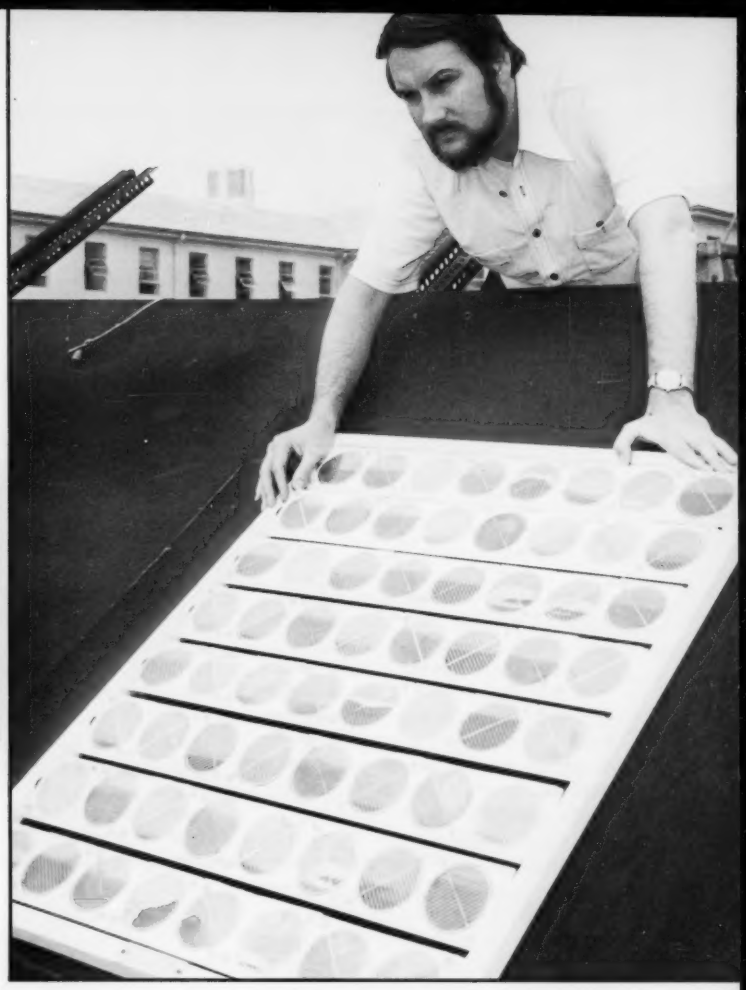
- Develop a training program that insures experience and exposure to all areas of professional practice.
- Obtain assignments at duty stations near Engineering Field Divisions (EFD). Assignments should be of the type that will insure proper experience. Where assignments do not provide for such exposure, it may be possible to obtain such training during off-duty hours.
- Arrange for a registered architect at the EFD to monitor and provide professional guidance and counseling in the pursuit of work.
- Maintain detailed records of training and experience and have them certified by the managing or supervising registered architect. Keep copies of drawings, specifications, engineering computations, studies and renderings; and photographs of models and buildings worked on. Submit documentation to support application.

The examinations are prepared by a committee of the NCARB, but NCARB does not administer the examinations. Examinations are administered by the State Registration Boards, and each Board has its own rules for admission to its examination.

Many Boards have adopted the NCARB standards of education and training as their standards for admission to examination and registration. However, others have different standards. Interested persons are urged to contact the Registration Board in the state where you wish to be examined for that board's policy concerning credit for military experience.



Getting A Full Day's Work From The Sun



ARRAY — This panel of photovoltaic cells sandwiched between two panes of window glass may help the nation — and the Navy — meet demands for household energy in the future. The photovoltaic cells convert sunlight directly into electricity while supplying shade to a house.

• Port Hueneme, Calif.

A new type solar energy window is under development at the Civil Engineering Laboratory (CEL), Naval Construction Battalion Center, Port Hueneme, Calif.

Looking like a three-pane storm window, it features a middle panel of plastic slats on which a series of photovoltaic cells are located. This configuration — two panes of common glass sandwiched around an energy-absorbing venetian blind-type device — serves three functions: it provides heat to a house, generates electricity and serves as a sun shade.

The photovoltaic panel was conceived by Dr. Richard Field, research mechanical engineer in CEL's Energy Program Office. He said a triple window of three panes of common glass, at times, could introduce too much heat into a room. But with a middle panel of photo cells, heat can be collected and distributed elsewhere while still warming the room in which the window is installed.

Normally much heat escapes through windows. Dr. Field adapted commercially available photovoltaic cells to diminish heat loss by channeling it for practical use as energy. The entire CEL panel (panels may vary in number of cells and slats) has 64 cells, or eight cells a slat. Each cell is three inches in diameter and contains specially treated silicon to generate electricity. In this array, the cells produce enough energy to charge a battery with 25 watts of power.

The cells use the sun's energy to cause electrons to jump a barrier and produce voltage. Each cell has a grid work of tiny wires that gather current from the cell's surface. Individual wires are in series to achieve desired voltage. Current is conducted to terminal blocks at the bottom of the panel.

Since a photovoltaic cell converts about 10 percent of the sun's energy into electricity, the system will use the balance of potential energy. The CEL triple window allows air to circulate over the cells, keeping them cool, while distributing excess heat to other parts of the building. Photo cells have proven more efficient when kept cool.

Once the cost of photovoltaic cells is reduced, the solar energy window could become an inexpensive device to generate electrical power for a house. The cells cost about $30 a watt. The CEL experimental panel costs about $1,000. A more recent procurement of cells by a government laboratory averaged $15.50 per watt. It is expected in 10-20 years, mass production will reduce this to about 50 cents a watt.

Solar experts predict that if a roof were covered with $3,000 worth of photovoltaic cells (at 50 cents a watt) they would generate more than enough electricity to run an average house.

N.A.L.S.

By WILLIAM J. EDDY *and*
RICHARD T. ADAMS
Installations Planning Division
NAVFAC HQ

Navy Ammunition Logistics System

• Alexandria, Va.

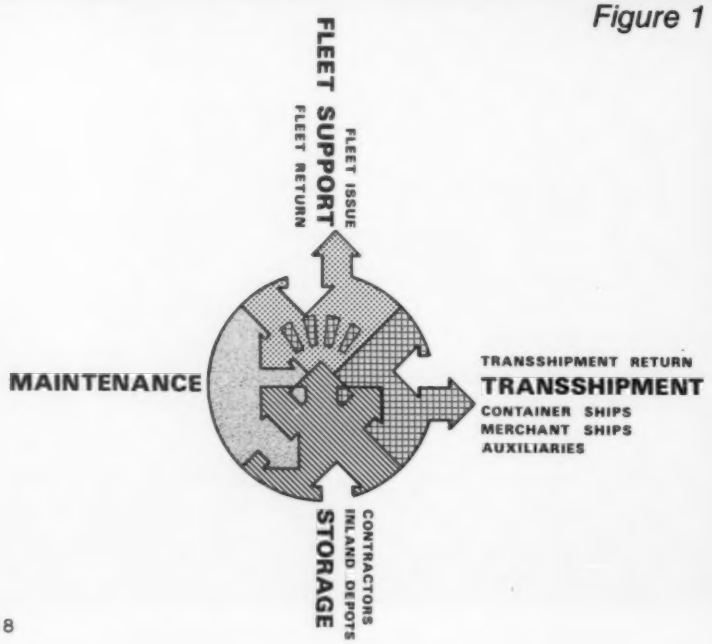
The Naval Ammunition Logistics System (NALS) study is one of the first systems planning studies to be accomplished by NAVFAC and a systems command. If the installation master planning program has had a weakness, it has been the insufficient overview of how a specific installation fits into the larger scheme of things.

Planners have been aware of this problem since the advent of the master planning program. Since the naval shore establishment is a series of systems which support operating forces, the logical way to plan for shore facilities is to begin with these systems at the largest scale and work down.

The logistics system, involving the supply of ammunition, was selected because of the urgent problems concerning ammunition and because of the planning experience which NAVFAC has in this field. The concept for the study originated in the late 1960s with preparation of several master plans for ordnance installations on the west coast.

Early in 1975, a preliminary scope of work was developed by representatives from NAVSEA, NAVFAC and CNO (OP-41) for the western portion of the NALS study. By April 1975, NAVFAC had received the concurrence of CINCPAC, CINCPACFLT and COMNAVSEASYSCOM. At that time, a planning team from NAVFAC, working with CINCPACFLT and NAVSEA, directed its efforts toward the study.

Figure 1



The geographic area considered in the first portion of the NALS study includes the continental United States from the inland points of ordnance manufacture and bulk storage through the west coast transshipment and outloading locations, to areas of storage and distribution in the middle and western Pacific.

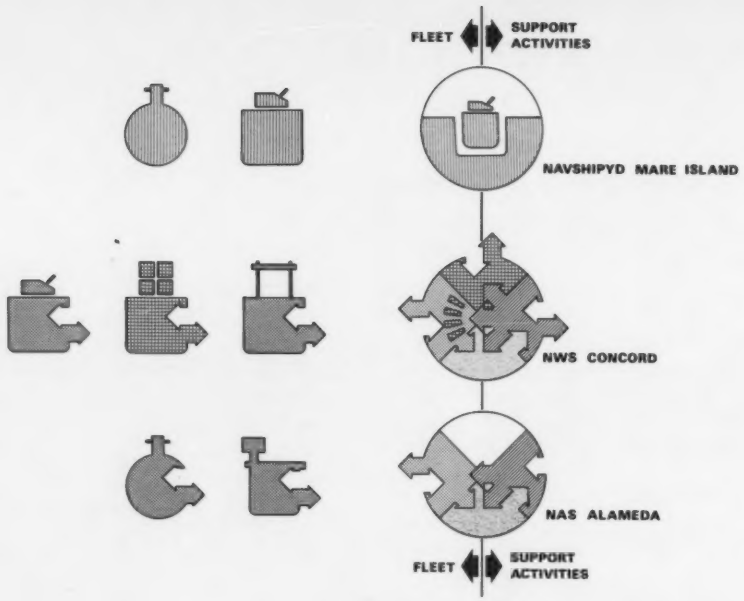
WESTDIV and PACDIV play important roles in the study and provide expertise on installations and areas under their geographic cognizance. NAVFAC and NAVSEASYSCOM are the Washington level coordinators.

A subsequent portion of the study will deal with ordnance facilities in the eastern United States and throughout Europe.

Due to the size of the undertaking, the study will be conducted in three phases. The initial phase will provide an overview of the western portion of the Ammunition Logistics System, geared to produce a summary of the major problems facing the system.

Much of the effort will entail a review of completed and ongoing studies, interviews and informal discussions. Data gathered during this process will be analyzed and put into easily understood and quickly retrievable forms.

The study will address all aspects of the Navy's ammunition logistics system. Five major functions determine how each installation



SAN FRANCISCO BAY AREA

Figure 2

fits into the total system. These include fleet support, maintenance and assembly, storage, transshipment and transportation.

Fleet support provides a look at how effectively the various types of ships can be serviced by an installation. Maintenance and assembly are an evaluation of an activity's ability to maintain and renovate major types of conventional weapons, as well as assemble components for weapons such as missiles and torpedoes.

Several installations are involved with shipments of wholesale quantities of ordnance and include transshipment as a function. Transportation would include both access and egress to the installation as well as ordnance handling.

Figure 1 is a graphic representation of the relationship of functions at a given installation. The four functions indicated on the graphic are represented by their respective quarter of the circle, while the transportation function is indicated by the arrows entering and leaving the quadrants.

Arrows within the circle indicate the flow of ordnance within the installation from one function to another, while the arrows pointing into or out of the circle show how ordnance is received or shipped.

To analyze the entire system the individual installations should be shown in relation to one another. Figure 2 illustrates the flow of ordnance in the San Francisco Bay area. The ship silhouettes represent the type of ships serviced at these installations.

A symbol of a shipyard is used to indicate the activity performed at Mare Island. The arrows entering the storage areas would represent a flow of ordnance from the inland depots. Further analysis would compare geographic areas similar to the bay area with other west coast areas. This process would be carried out until the entire system was represented.

In addition to the flow diagrams, a matrix will be used to evaluate the degree to which an installation is capable of performing its mission, relative to each of the five major functional areas. With the analysis of this information will come an understanding of the problems that exist in the present system.

The second phase will develop and propose alternative solutions to the problems uncovered in phase I. In addition, it will determine priorities for further, more detailed studies. The third phase will incorporate planning solutions developed in phase II for individual activities into NAVFAC and NAVSEA documents.

The first phase of this study is presently nearing completion, and the second phase is scheduled to begin early in FY77. No specific time frame can be cited for phase III. The third and final phase will entail updating existing documents, including established NAVFAC programs such as the Shore Installations and Facilities Planning and Programming System (SIFPPS) and the Master Planning Program.

The systems approach will provide the Navy planning program with a clear understanding of how a specific installation fits into an overall scheme.

This would allow the development of a base to be guided by its role in the total system rather than by the limits of the station boundaries. Planning in this manner will provide a tool that is equally effective at both the installation level and at the systems command level.

Lanthanum Pentanickel + Hydrogen

A PROMISING HEAT PUMP AND E

A simple, temperature-pressure exchange device offers promise of low-cost heating and vast energy from the oceans.

By SAUL WOLF
Naval Underwater Systems Center
• Newport, R.I.

It is with frustration or, at the very least, apprehension that we view the pressures put on this and other oil-consuming nations by the Organization of Petroleum Exporting Countries.

Means for reducing oil consumption are under constant study. Attention is now being given to the possibility of a hydrogen economy with hydrogen generated in central power plants and distributed by a nation-wide network of pipe lines. It would be generated continuously, with the excess stored during off-peak consumption hours for later use. It could be burned for comfort heating in residential and industrial structures and fuel individual on-site or area electric generators. Private and public transport could be hydrogen, rather than petroleum, fueled.

Alternatives or supplements to fossil fuel are in the public eye. Programs are focusing on solar, tidal, geothermal and wind energy. Atomic power plants are being pushed.

Conservation of fossil fuels is a national policy. We are all involved with it in our daily lives. We turn our thermostats down, organize car pools, limit our driving, turn off air conditioners and unnecessary lights.

Heat pumps are inherently energy-use-effective devices and have been with us for a long time. Almost unlimited natural gas and petroleum at low cost limited their acceptance for comfort heating and air conditioning.

Now that energy costs are so high, heat pumps are beginning to gain wider acceptance. If their performance could be made higher and their "hot-side" temperature increased, heat pumps could come into their own.

This article deals with the concept of a heat pump with potentially higher performance and higher output temperatures than conventional.

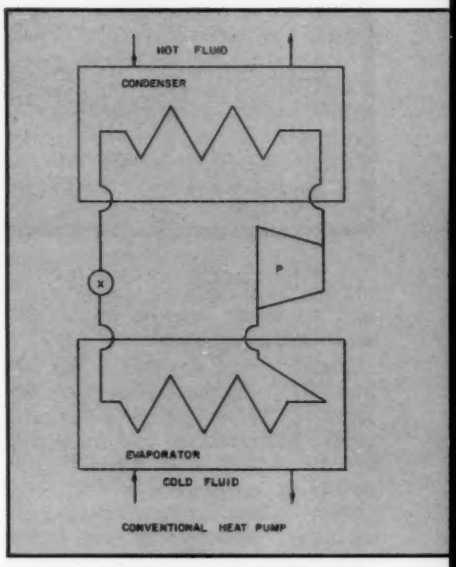
In 1972 at the Intersociety Energy Conversion Engineering Conference (IECEC) in San Diego, work at the Naval Underwater Systems Center (NUSC) with hydrogen sponges was first reported, and a paper on more recent work was presented at IECEC 1975 at the University of Delaware. During the past three years many activities, including NUSC, have investigated hydrogen sponges.

We have, for example, designed and built a hydrogen sponge-fed fuel cell mine power source. The full scale demonstration model operated continuously for almost a year — until it was shut down when the program ended. In FY76 hydrogen sponge efforts at NUSC have been supported by Naval Facilities Engineering Command.

As anyone who works with hydrogen sponges soon discovers, they can become too hot to touch during charging and noticeably cold when discharged. Observation of this heating-cooling phenomenon led to the concept for a rather unusual thermodynamic cycle — the hydrogen sponge heat pump cycle.

This novel cycle differs from the "conventional" heat pump cycle in these major respects: hydrogen is used as the working medium instead of freon or other condensible gas; heat is transferred by absorption and desorption of the working medium instead of vaporization and condensation of a refrigerant; and the cycle requires periodic working medium flow reversal.

A hydrogen sponge is a material which can selectively absorb hydrogen endothermically and desorb it reversibly and exothermically. A useful sponge is one in which absorption and desorption can occur at moderate temperatures and pressures. Lanthanum pentanickel ($LaNi_5$) is a most useful hydrogen sponge, the one on which the calculated performance values in this article were based.



Standard — In a conventional heat pump, a working medium such as freon is cooled in an evaporator, compressed by a pump (P), and transfers its heat of compression to a second medium in a condenser. Freon is contained in pipes as part of a closed system.

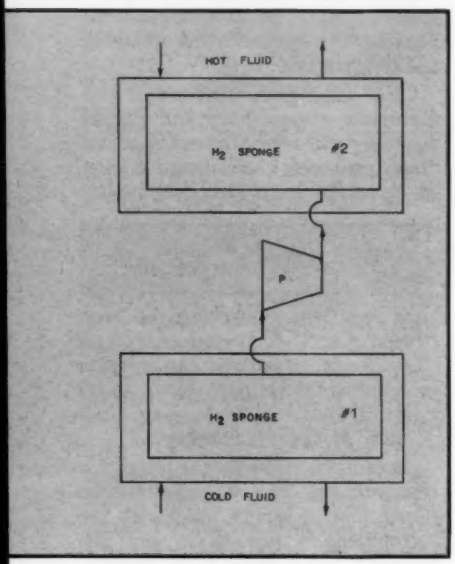
$LaNi_5$ is a rare-earth intermetallic compound, made quite simply by alloying stoichiometric quantities of lanthanum and nickel. Lanthanum is obtained commercially from mischmetal, an ore of which it is a major constituent. The hydrogen sponge capacity of $LaNi_5$ is quite remarkable when compared with other systems.

The pressure at which hydrogen is absorbed on or desorbed from

GINE

$LaNi_5$ is a function of sponge temperature. It is interesting to note that a temperature differential of 100°F can be obtained with a pressure differential of only 100 psi. This pressure-temperature relationship is what makes a hydrogen sponge heat pump cycle interesting.

A heat pump is a device in which heat can be transferred from one temperature level to another, moderately higher, temperature level. The operation may be carried out for heating or cooling; thermodynamically the operations are the same. The lower the work input per unit of heat delivered, the higher the performance of the heat pump.



Sponge — In a hydrogen sponge heat pump, hydrogen at a low temperature is compressed in a pump (P) and transfers its heat of compression to a sponge, possibly of Lanthanum Pentanickel, which then transfers the heat to a working medium (hot fluid).

The heat source can be outdoor air, surface water, well water, the sea or even the ground itself. A closed refrigerant circuit is used in the conventional heat pump for the transfer of heat between source and receiver. A typical conventional heat pump used for simultaneous heating and cooling is shown schematically in the diagram.

The heat necessary to vaporize the refrigerant in the evaporator is supplied by the ambient source which is itself cooled. The vaporized refrigerant is compressed and delivered to the condenser and transferred to the latter's ambient. The liquid refrigerant passes through the expansion valve (where its pressure is reduced) to the evaporator and the cycle is repeated. Flow is uni-directional.

Figure 2 is a simplified flow diagram of a hydrogen sponge heat pump. The heat necessary to desorb hydrogen from sponge (1) comes from its ambient. Since this ambient heat source is relatively cold, the pressure at which the hydrogen is released is correspondingly low. The hydrogen is pumped to a pressure corresponding to the temperature desired for output.

At this pressure the hydrogen is absorbed exothermically in sponge (2). Heat is released (90 Btu/lb $LaNi_5$) and transferred to the ambient of sponge (2). Heat release continues until sponge (2) is saturated. At this point sponges (1) and (2) are interchanged and the process is repeated. The process, therefore, is one of periodic flow reversal.

In real life, of course, the sponges would not be interchanged. Flow reversal would be accomplished by shuttling valves.

Cost reduction benefits with a hydrogen sponge heat pump have been examined. The energy cost of oil-fired furnace comfort heating has been compared with the hydrogen sponge heat pump in the Newport, R.I., area with comparative results shown below. For example, oil for a conventional boiler would have to cost 11 cents a gallon to equal the cost of a hydrogen sponge heat pump using electricity at 2.2 cents per kilowatt hour, a pump pressure ration of seven, and receiver temperature of 146°F.

Even at the high local electric utility rates inflated by the fuel adjustment charge, the equivalent hydrogen system energy costs are striking when compared to local fuel oil cost of approximately 40c per gallon.

The coefficients of performance for a Carnot Cycle system, an F-12 freon heat pump system, and the hydrogen sponge heat pump system were calculated for the reversible adiabatic compressor ($n = 1.00$) and the real compressor ($n = 0.80$) cases. The theoretical cycle performance advantage of the hydrogen sponge system over the conventional system increases with compressor pressure ratio and output temperature. In the 100-psi compressor outlet case, the advantage is some 23% in favor of the hydrogen sponge system.

The hydrogen sponge cycle has two obvious major applications: comfort heating/air conditioning; and in ocean energy systems as a heat engine. In this application heat is transferred from one temperature level to another, moderately lower, temperature level. In the process the hydrogen being transferred from one sponge to the other passes through an expander and useful shaft work is taken off. In ocean energy schemes the temperature differential comes from near-surface and deep thermal layers.

There appear to be no technological obstacles to construction of a demonstration hydrogen sponge heat pump. All components are state-of-art. The cost of $LaNi_5$ is high, but in quantity may drop to $10-12 a pound. Heat transfer coefficients for sponge-to-wall conditions remain to be determined. The extent of hydrogen diffusion through compressor seals, exchanger walls, etc., must also be examined.

Development problems appear small compared to the potential pay-off.

Cost per BTU output from a hydrogen sponge heat pump as specified below		equals	Cost per BTU output by an oil furnace if oil costs were as outlined below
Electricity Cost Per KWH	**Pressure Ratio**	**Receiver Temp.**	**Oil Cost Per Gallon**
* $.022	7	146°F	$.11
* .022	5	122°F	.086
* .022	4	110°F	.072

* Navy/Newport rate (Source Temp. + 50° F.)

Got a minute? Get a hangar!

Hurry-up hangar — Quickly assembled arches are set up on prepared base rails and are held firmly in place by honeycomb fiberglass and foam plastic panels. The panels are grooved to fit on flanges on the arch beams. Model shown above can serve as F-14 hangar.

By REGINALD V. TUNSTALL
Materials Engineer, CESO
and
LT RICHARD H. PARRISH
CEC, USNR-R
RNMCB 16

• Port Hueneme, Ca.

The site . . . not Condord, Mass., but Naval Construction Battalion Center, Port Hueneme, Calif. The event . . . the simultaneous arrival of the "Minutemen" troops and two military cargo containers weighing a total of 46,000 pounds. The result . . . "presto," hours later, an Advanced Base Functional Lightweight Shelter containing over 6,000 square feet of floorspace, assembled far in advance of the normal ninety days required to put together a similar, but conventional structure.

Naval Reserve Seabees from Reserve Naval Mobile Construction Battalions 16 and 17, comprising the 1st Reserve Naval Construction Regiment headquartered at the Naval Reserve Center, Los Alamitos, Calif., were selected as the first military units to build the newly designed "Loc Arch" hangar as part of their annual Active Duty Training.

The objective of the development of the portable building was to provide a truly relocatable, expeditionary hangar facility that can be transported to an unimproved airfield in kit form and set up in approximately 22 to 36 hours of elapsed time, without special tools or heavy equipment, and a crew of only six men.

The hangar structure measures 76 feet in span, 88 feet in length, and 25 feet high, enabling it to house F-14 Tomcat fighter aircraft for maintenance and shelter.

The structure consists of twelve aluminum arch members, each

Building Quick, Low-Cost F-14 Hangars!

assembled at ground level and winched upright and footed into aluminum longitudinal base rails. Each arch consists of thirteen members which interlock with two tubular bushing pins at each joint. Similar bushings hold the foot of the arch into prefabricated clevis fitting weldments, located on the base rails. Twenty-three prefabricated, interlocking panels fit between each pair of arches and are assembled one at a time at the one side of the structure while being winched across the arch to the opposite side.

The panels are fabricated of foam-molded polycarbonate and incorporate an edge track, which facilitates their positioning between the arch members.

Doors at both ends of the structure are of the curtain type consisting of a fabric curtain (center opening) attached to six aluminum door posts which roll at their upper ends in a horizontaly mounted trolley beam assembly. Each door is cable and winch operated to open and close. The outer posts at each side of the door assembly are fixed into position with the fabric closure attached thereto and a smaller access door is located within these areas on both sides.

The majority of fittings used throughout the set-up process are of ball locking pin and bushing bolt design. The larger structural bolts are locked in position with clinch pins (modified cotters).

The entire structure can be assembled on unimproved land with minimum bearing of 1500 psf and does not require a level concrete pad for ground support. For the purposes of this developmental test performed at Port Hueneme, Construction Equipment Department (CED) personnel accomplished the foundation grading and preparation.

CED also gave technical and materials support on the initial assembly and alleviated many of the minor problems encountered during set-up by fabricating anchors for the base rails and reworking the arch fitments at the clevis joints. The "Loc Arch" structure can sustain environmental loadings of up to 90 knots of wind and live loading, such as snow, of 40 psf maximum.

Assembly time is targeted for one-and-one-half manhours per linear foot of length, and with the recommended crew of six men, the requisite 132 manhours to completion can be accomplished in 22 hours elapsed time.

The next phase of practical development will include disassembly and reassembly by Marines from Marine Corps Base, Twentynine Palms, with subsequent shipment to the Marine Corps for temporary use as an aircraft maintenance facility.

In this project, Reserve Seabees have again demonstrated the flexibility required to respond immediately and adapt to new weapon systems criteria and to support any contingency.

The mission continues to be immediate readiness. The men of Concord would have said, "Minutemen, these Seabees . . ."

Important
Interesting
Intriguing

People
Places
Particulars

THREE GENERATIONS — of Civil Engineer Corps officers are represented by the Moeller family. They are (L to R) Capt. Griswold L. Moeller, CEC, USN (Retired); RAdm. Lewis N. Moeller, CEC, USN, (Retired); and Lt. Cdr. Robert L. Moeller, CEC, USN. Lt. Cdr. Moeller is ROICC at the Naval Air Station, Corpus Christi, Tex.

Retiring type once 'gangster'

All kidding aside, it turns out recently retired LantDiv CO, **RAdm A. W. Walton** was a child star — in the "Our Gang" comedies, no less! Adm Walton, who retired June 24, 1976, has one earlier retirement to his credit. He retired at age nine from the movies after having played across from "Buckwheat," "Alfalfa," and "Farina."

Adm Walton said he has never missed movies and insists he got the role only because he "was in the right place at the right time." He said having long curly hair — at that time — helped.

Adm Walton graduated from the USNA in 1945 and was originally assigned to destroyers.

Top conservers

A conservationist panel convened by the CO of NAVFAC and the Marine Corps Commandant named four stations winners of Navy Natural Resource Conservation Awards for the three years ending with calendar year 1975.

Winners are divided into Navy and Marine corps installations larger than 5,000 acres and installations smaller than 5,000 acres. Large installation winners are NAS Meridian, Miss., and MCB Camp Lejeune, North Carolina.

Small installation winners are the Navy Weapons Station, Seal Beach, Calif., and the Marine Corps Supply Center, Albany, Ga.

An honor for Capt Reed

The American Public Works Association selected **Capt William F. Reed, Jr.,** CEC, USN, one of the top ten public works men of the year. Capt Reed, Deputy Commander for Facilities Management at NAVFAC HQ, was chosen from among scores of nominees for the honor.

The association said his selection was based on his work which "reflects the highest standards of professional conduct," and whose achievements "are characterized by the wise use of manpower and funds."

Capt Reed is the only military or federal official selected this year and only the fifth naval officer so honored.

CHESS WIZARD — Manny Arzadon is congratulated by Capt. Donald L. Conner, CEC, USN, Subic Bay, Philippines, for winning a chess match last July against International Grandmaster Walter S. Browne. Arzadon, an architect, is the 1975-1976 Inter-Command Athletic League (ICAL) Individual Chess Champion.

Capt William R. Bannister relieved **Capt Eugene L. Pickett** as CO of SouthDiv June 30; **Capt John P. Jones, Jr.,** relieved **Capt Jack C. Rickles** as CO, Atlantic Fleet Seabees; **Capt Malcolm T. Mooney** relieved **Capt Robert R. Raber** as CO, PWC San Francisco June 30; **Capt Donald L. Conner** relieved **Capt Joseph D'Emidio** as CO, PWC Subic Bay July 23; **Capt Irwin D. Corwley, Jr.,** relieved **Capt Carl Courtwright** as CO, PWC Yokosuka July 27; **Capt William J. Burns, Jr.,** relieved **Capt Harvey A. Falk, Jr.,** as CO, PWC Great Lakes July 29; **Capt Ralph A. Smith III** relieved **Capt Malcolm T. Mooney** as OICC, Guam May 28; **Capt Ward W. deGroot III** relieved **RAdm Charles C. Heid** as CO, NorthDiv June 11; and **Cdr Charles L. Neugent** relieved **Cdr Herman W. Filbry** as CO, NCTC Port Hueneme May 28. **RAdm Charles C. Heid** relieved **RAdm A. W. Walton, Jr.,** as Commander, LantDiv June 25; **Capt Donald W. Wittschiebe** relieved **Capt Walter E. Marquardt, Jr.,** as CO, ChesDiv May 18; **Capt Paul D. Olson** relieved **Capt Charles M. Howe** as CO, WestDiv October 29; **Capt James T. Taylor** relieved **Capt Ward W. deGroot III** as CO, CBC Gulfport May 28; **Capt Edward J. Williams, Jr.,** relieved **Capt Claude E. Swecker, Jr.,** as CO PWC Pensacola July 30; **Capt Howard H. Haynes** relieved **Capt William E. Wynne** as CO, PWC Pearl Harbor June 30; **Capt James W. Weir, Jr.,** relieved **Capt Ernest R. Stacey** as OICC Trident August 26; and **Capt Russel P. Nystedt** relieved **Capt Kenneth D. Brooks** as OICC MidPac in August.

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CECOS, the Naval School, Civil Engineer Corps Officers, announces the FY 1977 Course Schedule for both individual and organizational career development planning.

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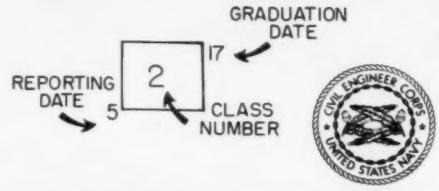
For telephone information call The Director of Academic Services, Area Code 805, 982-5655; Autovon 360-5655.

Readers attention is invited to the Environmental Protection course to be offered by CECOS Feb. 14-18, 1977, in Charleston, S.C. The purpose of the course is to train managers and planners to consider the environment during the decision-making process; to understand the causes and effects of pollution; to recognize laws and regulations requiring Navy compliance; and to work within funding requirements while planning and managing the Navy's pollution abatement program.

Other topics will be preparation and review of Environmental Impact Statements, solid waste management programs, Navy RDT&E, coastal zone management, oil spill cleanup, and natural resource management.

Teaching the course will be environmental program experts from OPNAV, NAVFAC, EFDs, the Navy Environmental Protection Support Service (NEPSS), the Environmental Protection Agency, and Navy field activities. The course is intended to benefit Navy, Marine Corps, and Coast Guard officers and civilians involved in planning, acquisition, public works, operations, and community affairs at headquarters, field division, and activity levels.

For further information and quota requests, call the Naval School, Civil Engineer Corps Officers, (805) 982-5655 or Autovon 360-5655.



NAVAL SCHOOL, CIVIL ENGINEER CORPS OFFICERS PORT HUENEME, CALIFORNIA

COURSE SCHEDULE FISCAL YEAR 1977 (REVISED)

	COURSE
1	CEC BAS QUAL
2	PUB WKS MGT
3	PUB WKS MGT ACEL
4	CONTRACT ADMIN
5	CONTRACT ADMIN ACEL
6	CONST BN OPS
7	CONST BN OPS ACEL
8	MIL JUSTICE CECO
9	GRP VIII ADV MGMT
10	GRP VIII E6/7 MGT
11	NR G8 CBOPS/MGT
12	NR CECO DRIL TRA*
13	CEC OFF REFRESH
14	SHORE FAC PLAN
15	SHORE FAC PLAN SPEC**
16	ECONOMIC ANAL **
17	CONST MGT
18	PCO/PXO INDOC *
19	NETWORK ANALYSIS **
20	CONST CON NEG **
21	NAVY INDUST FUND**
22	AICUZ FAMILIAR
23	ENVIRON PROTECT**
24	ENERGY MGT**
25	NAV FAC SYS MGT
26	POPS INDOC *
27	INSTALLATION PLANNING

MONDAYS → JAN FEB MARCH APRIL MAY JUNE JULY AUGUST SEPT

3 10 17 24 31 7 14 21 28 7 14 21 28 4 11 18 25 4 11 18 25 2 9 16 23 30 6 13 20 27 4 11 18 25 1 8 15 22 29 5 12 19 26

1: 142 (6–4) | 143 (7–3) | 144 (14–9)
2: 94 (7–4) | 95 (9–3) | 96 (15–9)
3: 10 (28–8) (EAST) | 11 (20–1) | 12 (25–5)
4: 94 (7–4) | 95 (9–3) | 96 (15–9)
5: 19 (28–8) (EAST) | 20 (9–20) | 21 (13–24) | 22 (11–22)
6: 74 (7–4) | 75 (9–3) | 76 (15–9)
7: 10 (9–20) | 11 (11–22)
8: 31 (7–11) | 32 (6–10) | 33 (12–16)
9: 23 (5–12)
10: 12 (31–11) | 13 (28–6)
11:
12:
13: 10 (19–)
14: 66 (25–5)
15: 29 (3–7) | 30 (28–1) (EAST) | 31 (23–27) (HAWAII)
16: 26 (10–14) | 27 (4–8) (EAST) | 28 (31–3) (HAWAII) | 29 (8–12)
17: 13 (28–8) (EAST) | 14 (23–3) | 15 (1–12)
18:
19: 36 (27–1)
20: 26 (4–8) (EAST) | 27 (20–24) | 28 (18–22)
21: 67 (17–21) S.F. | 68 (7–11) | 69 (6–10) | 70 (12–16)
22: 13 (9–10) | 14 (6–7)
23: 9 (14–18) (EAST) | 10 (20–24)
24: 9 (7–11) (EAST) | 10 (13–17)
25: 2 (14–25)
26:
27: 1 (11–22)

*Scheduled as required

**Courses scheduled to facilitate two-week ACDUTRA and others

HOLIDAY WEEKS →

HOSPITALS — To offer the best in health care, the Navy has begun many modern hospitals, including the 120-bed facility at Roosevelt Roads, Puerto Rico (above); the 125-bed medical center at New London, Conn., (above right); and the 600-bed center at Camp Pendleton, Calif., (below).

For Better Navy Health Care . . .

By CHARLES A. O'CONNOR
Ass't Construction Division Director
NAVFAC HQ

• Alexandria, Va.

Over the past few years the Department of Defense has committed itself to replacing or updating medical facilities. To this end, the Navy allocates a generous share of its Military Construction Program, annually, for this purpose. As a result, title has been taken to seven new naval hospitals and one large hospital addition during the last few years.

These facilities provide 2,350 acute care beds and were constructed at a cost of more than $96 million. Also during this time, four naval hospitals were modernized and upgraded at a cost of $19 million.

Three naval hospitals are now under construction. Naval Hospital New Orleans (250 beds) will be completed late this fall at a cost of about $20 million. In conjunction with the complete modernization of the National Naval Medical Center, Bethesda, the hospital will be replaced with a 750 bed ultra-modern $100 million facility. The modernization project will cost $125-150 million before it is finished in late 1979 or early 1980.

The Naval Hospital Bremerton replacement has only recently been placed under contract and will provide 130 acute care and 40 light care beds at a cost of $30 million. Completion is scheduled for November, 1978.

Design is in progress for replacement hospitals at Orlando (104 beds) and Port Hueneme (60 beds) at estimated costs of $23.8 and $17 million respectively. Orlando should be placed under contract in the spring of 1977 with Port Hueneme following one year later. Concept plans have been completed for replacing the Camp Lejeune Hospital (280 beds, $51 million); however, the project is not now part of an active Military Construction Program.

A large percentage of the Navy's hospitals have been replaced or modernized or will be within the next few years and construction costs have been ever increasing. As an example, the cost of the 60 bed facility at Port Hueneme will be over twice that of the 120 bed Roosevelt Roads Hospital.

However, these increases can't all be blamed entirely on construction cost inflation. Changes in health care concepts, medical equipment, outpatient facilities, etc., all contribute to increasing space requirements. The Roosevelt Roads Hospital has 125,200 square feet; however, Port Hueneme will require 120,000 square feet to support fewer beds, but a larger out-patient load.

The greatest effort in replacing Navy hospital facilities is yet to come. Replacing the sprawling Naval Regional Medical Center, San Diego — the largest military hospital in the world — will be the next undertaking. With over 70 buildings, some more than 50 years old, it now has authorized over 1,900 beds and accommodates an average of almost 2,000 outpatient visits daily.

Many studies over the past few years all conclude the facility should not only be replaced, but should also be moved to a new site.

The Balboa Park site is so congested it would be impossible to build without major disruption to daily hospital functioning. Also, it lies directly under the flight path of commercial aircraft using nearby San Diego International Airport. This creates noise and potential safety problems.

For these reasons the Navy is seeking to buy land in Murphy Canyon, near the navy housing area, where a new facility could be constructed for about $224 million. An architect-engineer firm has been selected to design the new facility once Congress authorizes planning. Construction would start in 1979 and be completed in five years.

CONST-RUCTI-ONESE

By ROBERT A. RIVERS
Civil Engineer
Naval Ship Research & Development Center
• Annapolis, Md.

Semantics in the construction world stands apart, in many aspects, from everyday language. Words, terms and meanings differ from the accepted norm and ignorance can sometimes be disastrous.

For example, the adjective "identical" is perhaps the most dangerous word to insert into a contract specification, although a lawyer can make liberal use of that word with impunity. It's all right for the lawyer, who deals with abstract matters, but not for the engineer, who knows that no two tangible items — any more than two drops of water from the same source — are absolutely the same physically or chemically.

The "spec" writer who used the word "similar" rather than "identical" allows more room for movement in interpretation of the contract and could avoid some embarrassing claims.

Some words are so proprietary to the industry they seldom appear in dictionaries or even in handbooks. The "wythe" of a cavity wall is not described in dictionaries although it is often used in masonry publications and standard Navy specifications.

Architectural items are likewise confusing when two meanings are possible: the word "dado" will mean a cut in a board to the carpenter, but on a Finish Schedule it will represent a wainscoat (also spelled wainscote); an "astragal" is defined as a molding by Webster, but it more often means a stop or weatherstrip on double doors, and few publications bother to define this term clearly.

The highways and roads departments, again, develop terms of their own such as Bituminous Concrete instead of Asphalt Pavement, wedging versus feathering out in paving, and the word "culvert" for a bridge structure that is less than 20 feet long.

Their surveyors, further, are aware that an "error" within allowable limits is unavoidable but a "mistake" is a plain goof that is not excusable.

Contractors also provide their share of unusual and sometimes amusing unwebsterized use of the language. Terms that come to mind include "funny papers," an irreverent term for the contract drawings, "Norwegian Stream" to mean a maximum effort to get the work back on schedule, and, of course, "Live-With Condition" to mean what-else-can-you-do-now-fella?

We should, perhaps, credit contractors for "hellacious paperwork" (probably had to do with submittal of payroll data) and "Impact Claim" which results when a small change order is initiated and the contractor alleges it threw the whole job off schedule.

Semantics is an essential part of construction and will continue to make this profession interesting and hectic. It is in our interest to avoid making it any tougher than it is, or, to paraphrase an old spec writer, to "eschew obfuscation."

Naval Construction Force Review

By LT JAMES L. DELKER, CEC, USN
Seabee Division, NAVFAC HQ
• Alexandria, Va.

NMCB Deployment Schedule

Since June 1975, Naval Mobile Construction Battalions (NMCBs) Seventy-One and Ten have been disestablished, which has reduced the Naval Construction Force (NCF) to eight active NMCBs. Even though the number of active battalions has decreased, the five deployment sites, Diego Garcia; Guam; Roosevelt Roads, Puerto Rico; Rota, Spain; and Okinawa have remained unchanged.

With the decrease in the number of battalions and holding to a constant the 8-6 deployment cycle, the NCF can man only four-and-one-half of the five deployment sites with full battalions. Adjustment in the deployment schedule was required.

The time-tested cycle for NMCB deployments of eight months on deployment and six months in homeport has proven over the years to provide optimum training, personnel and project planning and contingency readiness. High priority is placed on unit rotation of Seabees preserving this 8-6 deployment cycle.

Many alternatives covering the gamut of advantages and disadvantages of scheduling eight battalions at five deployment sites were considered.

The selected scheme is to divide battalion personnel and have one-half at the deployment site and the other half in homeport. The two halves of the battalion would then alternate between homeport and the deployment site on an 8-6 rotation cycle.

This will allow a two month overlap period once every 14 months during the eight month portion of the deployment cycle in which both halves of the battalion personnel will be together. This provides the advantages of not gapping a deployment site, providing continuous manning at the deployment site with air det. capability in both deployed battalion halves, maintaining the proven 8-6 cycle deployment schedule and preserving unit rotation of Seabee personnel.

A schedule using the continuous manning of a deployment site by part of a battalion has been approved by CNO. In April 1977, NMCB Three will begin this deployment scheduling concept on Okinawa. The two halves of the battalion will make unit movements on the standard 8-6 cycle schedule.

ELECTRIC CARS?

By S. J. WALL
Director, Transportation Division
NAVFAC HQ
• Alexandria, Va.

Interest in electric powered vehicles is again being revived. The effect of air pollution and the energy crunch of the 1970s has again directed attention to the electric powered vehicle as a partial solution to worries about petroleum shortages and the need to improve air quality.

A very popular issue has been the electric passenger car on which an avalanche of newspaper articles and sales promotion releases has recently appeared. Many express the optimistic and oversimplified view that the new electric car is just about ready economically to solve the long term energy problem.

The impression is frequently given that the final effort needed to turn the technological corner is a large expenditure of development funding, testing and a demonstration project. The more detailed professional technical writings, however, are not so optimistic.

Technical groups, such as the Society of Automotive Engineers which has published over eighty papers on electric vehicles, present details of the many difficult problems yet to be resolved before real improvement in electric vehicle capability is a reality.

Although the electric vehicle has existed in the United States for over 60 years, commercial feasibility as a competitive vehicle has yet to be fully demonstrated. At this time various electric passenger vehicles (exclusive of golf carts) exist in the United States only in the thousands and are being produced at the token rate of only about 2500 annually.

As a comparison, conventional gas diesel engine driven motor vehicles in the United States now exceed 130 million of which over 107 million are passenger cars.

The main limitation with the electric car is energy storage. Cruising range on current model electric cars is usually 30 to 50 miles depending on the number of batteries, vehicle weight, temperature and related factors. Many different electric energy storage batteries have been used but the most economical and most frequently used is the heavy duty lead acid battery designed for higher discharge rates.

Various tests have also been made with nickel-cadium, silver-zinc, zinc-air, sodium-sulfur and certain experimental batteries. Depending on weight of the vehicle, and the projected mileage range, 8 to 36 batteries weighing from 500 to 2500 pounds are used. The many factors which affect the vehicle's mileage range and capability are battery discharge factors, number and size of batteries, tire rolling resistance, vehicle weight, vehicle drag, transmission losses and controller/motor losses.

Aside from environmental pollution advantages, one of the main selling points for the car is the very low maintenance and operating cost with the figure of one cent per mile being frequently cited. This cost, however, usually represents only battery charging expense and does not include battery replacement which is a significant cost.

At this time electric vehicle applications are basically limited to warm climates, daylight hours and the avoidance of urban main streets and high speed roads. An additional power problem for the electric vehicle is the energy required for lights, windshield wipers, heater and blower.

Consumer and safety critics are now beginning to express doubts about electric cars for reasons of protective safety to passengers occasioned by these light bodied vehicles and the sheer physics of a collision with a one to two ton vehicle.

Also, in the event of collision or upsetting, the containment of sulphuric battery acid to avoid dumping on the passengers or roadside is yet to be adequately addressed. With additional exposure to traffic hazards the full gamut of safety exposure is expected to develop some difficult problems.

Many federal agencies are engaged in the various aspects of fleet testing and evaluation of electric cars. The U.S. Postal Service uses a small fleet of electric cars for well defined, stop and go routes of limited range. The U.S. Navy has a small fleet of 135 vehicles and has used electric vehicles in small numbers (exclusive of electric fork lift trucks) for over ten years. Use is for selected operations which do not require trips of any distance from the central work area or operation on public highways.

Perhaps the best application is in congested areas, warehouses, and aircraft flightline repair operations. Where the operation is continuous, partial midshift recharging of batteries is advantageous. The degree of usefulness is almost directly proportional to the degree of management interest and control. Electric vehicles are not used where travel in cold weather is required (where capability of the battery sharply declines), rough access roads or where gradeability is a requirement.

While it may be possible to expand use of the electric vehicle, the conclusion is that it has a very long way to go to provide real competition for gas and diesel powered vehicles.

A few major technical problems remain before electric vehicles are practical

REAL ESTATE

By LCDR ALLEN J. STEWART, CEC, USN
Head, Facilities Planning Department
North Div NAVFAC
• Philadelphia, Pa.

Sites for most naval activities were selected years ago in locations remote from residential areas. But urban sprawl has reached the point where potential civilian encroachment is a threat to some Navy property. Growth of communities near an installation often interferes with the activity's basic mission or its future potential.

Encroachment problems are not limited to highly populated areas where an installation is integrated with industrial, commercial, and residential land uses. However, in these situations the problem is more easily recognized and the results of unchecked encroachment more dramatic.

Curtailing or halting operations at some air stations, ammunition storage facilities, and communications stations because of off-base residential or commercial development are examples of encroachment problems which have progressed beyond the stage of effective control. New highway construction, industrial expansion, commercial airport operations, and recreational facilities are all potential encroachers. These, and similar developments, act as magnets which attract people into formerly unpopulated areas.

Compatible Land Use

Military activities near private neighborhoods often coexist harmoniously. However, the Navy's mission often creates uncomfortable or unsafe conditions outside the base boundary. In such cases, it is important to bar use of such land for all but compatible development.

Examples of mission-related hazards include aircraft accident potential, high noise levels, explosive quantity-distance hazards, and electro-magnetic interference. Also, new off-base construction may limit operations as when buildings penetrate aircraft glide paths and structures interfere with communications. Encroachment may be such that the military mission endangers nearby property or urban buildup restricts military operations. In either case, encroachment may curtail operations or, more drastically, force base closure.

Early recognition of potential encroachments and assessment of their impact on use of Navy real property is vital to protecting and maintaining the usefulness of Navy installations. Under OPNAVINST 11011.12A, the objectives of this program are to achieve compatibility between installations and civil communities. Basically, these objectives are:

- To ensure Navy investments in real property are protected and operational capabilities of installations are maintained;
- To reduce aircraft noise at and near air installations (AICUZ Program);
- To safeguard the safety, health, and welfare of the public from development incompatible with military operations; and
- To inform the public of the Navy program to safeguard real property, and of efforts to minimize the potential hazards of military operations near Navy installations.

CEC Officer Responsibility

While encroachment problems are the responsibility of the activity commanding officer, either the public works officer or staff civil engineer is usually asked to develop solutions. To preclude, or at least minimize, encroachment, CEC officers should take at least the following steps:

- Anticipate problems as far in advance as possible to minimize remedial action and cost.
- Work closely with local municipal and regional planning authorities to anticipate possible problems and make civilian planning authorities fully aware of continuing operational requirements.
- Use all available local authority to solve, where possible, external conflicting developments.
- Develop and recommend for implementation, alternate methods of accomplishing mission (e.g., revise flight patterns) to reduce environmental impact on the community.
- Submit an encroachment report as detailed in OPNAVINST 11011.12A. This report establishes procedures for identification, analysis, updating, and reporting of existing and potential civilian encroachment on Navy real property as well as keeping the chain of command, including EFD and Area Coordinator, informed of encroachment problems.

Involvement and Innovation

Several options present themselves as solutions to the problem of encroachment. More important than any other consideration is cooperation between the activity and community. An aggressive public affairs program at an activity which provides strong communications with local officials is best. Continuous monitoring of the local press, attendance at planning and zoning board meetings, and *involvement with the community* are not only highly desirable, but necessary to preclude loss of mission effectiveness.

CEC officers are encouraged to develop innovative methods of solving encroachment problems . . . one of the most serious issues facing the Navy's shore establishment today.

PROTECTING THE NAVY'S INTEREST

By LCDR LOUIS M. SMITH
CEC, USN
• Offutt, AFB, Neb.

The Civil Engineer Corps has a long and proud history in the United States Navy and we CEC officers are equally proud of our personal professional abilities as well as those of our fellow officers.

However, perhaps we wouldn't be so proud if we re-examined our definition of "professionalism."

What makes us naval officers and engineers vice *just* engineers?

We fill the need for facility managers, construction contract administrators, and advanced base constructors. (Granted, this is an oversimplification, but basically this is what we do.)

Significant in all this, however, is that the first two functions could easily be civilianized.

As a matter of fact, the organizations we work with in these areas are currently highly civilianized. Our day-to-day operations and contact with these people has already somewhat civilianized our mannerisms and actions. We are often only required to be *naval officers per se* while acting within the military chain of command at our duty stations. Further, as the advanced base construction (Seabee) portion of the Corps is reduced, our requirement to perform in a purely naval/military environment has decreased.

As the Navy (and our corps) has become smaller, the need for each of us to do his job better has increased tenfold. To this end, we have emphasized professionalism more strongly in our community. Unfortunately, we have been emphasizing the engineering portion (and I include engineering management in this), while neglecting the other, larger, portion of our field; that is, our role as professional naval officers!

Let me distinguish the *naval officer/engineer* from the *pure engineer*. The naval officer/engineer has some knowledge of *all* aspects of the naval establishment, including the operating forces and the support establishment. While the bulk of his knowledge is in his specialized field, he also has an appreciation and understanding of his customers and their role in the overall scheme of things.

The *pure engineer*, however, is unidimensional in his concern for his system and his facilities. The pure engineer will ultimately lose touch with his customers by his lack of concern for them and their problems. Obviously, then, the naval officer/engineer must have more professional knowledge than the pure engineer.

Each of us was educated (in our precommissioned training) to be a surface line officer. Only at the Civil Engineer Corps Officers School did we delve into the role of the Civil Engineer Corps and its

OPINION AND OUTLOOK: A VI

By LCDR KENNETH W. MEEKS
CEC, USN
• Camp Lejeune, N.C.

A few years ago a senior Navy Civil Engineer Corps captain was overhead advising a group of junior officers on possible methods of success in their careers.

One of the principal points that the speaker stressed was the importance of developing a good rapport with, and learning from, civil service employees. Most junior officers are placed where they will be working with, and even in some instances indirectly for, civil service employees. The junior officer's ability to work with these civilians successfully, and to learn from them while on the job, will often be key factors in his early performance.

Sometimes an officer's unwillingness or inability to get along with the non-military can limit his potentials. It is evident that some younger officers have immediate difficulties relating with civilian employees.

Probably the most important quality which an officer must recognize in the civilian community is that of continuity of the mission. The civilian employee shoulders extended responsibility as officers are transferred every two or three years. A civilian will sometimes remain in the same office for his entire career and, therefore, he becomes the resident expert on most matters as the officers come and go. The wise junior officer will quickly recognize this and will take advantage of the background information which the civilian can offer. Many times, simply asking what happened on a particular matter can save the junior officer hours of searching and digging (usually unsuccessfully) for an answer.

Another factor which goes hand in hand with continuity of service is the level of experience which the civilian has gained. It must be recognized by the young officer that experience is an asset which takes time to develop and does not come with his college degree. An officer can avoid many hard knocks and pitfalls by seeking counsel of the experienced.

The average civilian employee generally knows what procedures must be followed, what regulations are applicable, and who must be consulted to complete the desired action. There are instances when a young officer does not have the slightest idea of how to perform. He can waste a lot of time and expend a lot of energy, and still fail to accomplish anything, if he does not know what he is doing.

Now that some of the principal ways a civilian can assist an officer have been mentioned, what should a junior officer know in order to be more successful in relating to the civilian?

The officer must know how to handle a problem employee. The problem could be one of many, i.e. will not work, poor work, not qualified, chronic absenteeism, drunkenness or drug use, criminal offense, etc. It is possible to handle a problem situation of this nature within the civil service system. Many officers are of the mistaken opinion that nothing can be done

individual procedures. Since that time, we have all been striving to learn and master our naval facilities system. Unfortunately, in the process, we have ignored the bulk of our naval officer's skills to an extent where they are now nearly non-existent.

None of us has time to do all of the work we have, and the task of learning the system (as well as doing our day-to-day jobs properly) could easily fill a 30-year career.

Also, due to the time constraints, we could say that our current, limited, definition of professionalism helps exclude professional knoweldge of our customers; the Naval Operating Forces. Since the Operating Forces (the "fleet," if you will) are our ultimate customer, this is a sad indictment of our Corps. Our stress on "professionalism" has, in fact, become a stress on technical knowledge, not a stress on improving the overall naval officer.

We have reached the stage where some of us know little or nothing about the Navy and our role in it. For this reason, we have been criticized by our Line contemporaries as being solely interested in our Civil Engineer Corps system and not very interested in providing support. Since we are exclusively in a support role, interest and awareness of our customers' problems should enable us better to support them.

This concept of the CEC officer as a naval officer is not new to our profession, and it is certainly the Navy's intent that it be basic to it. As officers, we owe it to ourselves to be the *complete* naval officer, not just an engineer in uniform.

We obviously do not need to be able to fly an F-14, or dock a *Spruance* class destroyer. However, we should have a good idea of the problems associated with these actions, because they will ultimately affect facilities we are required to maintain or construct.

The situation is obviously ripe for change. But how should a program of reemphasis be implemented? Resolution of this problem must be taken as an individual officer's responsibility. We must *individually* realize that it is not enough to have a professional engineer's registration and a master's degree. It is not enough to know the 11000 series instructions backwards and forwards. We must understand the basic missions and responsibilities of the Navy.

Rather than read just the *Navy Civil Engineer* or *Public Works* magazine, we should read the *Naval Institute Proceedings* and the operational journals. We must realize that if the operators have a problem, then *we* as civil engineers have a problem, and only by understanding their problems can we ever hope to do our job adequately. *This* is what our concept of professionalism should and must include.

W OF THE CEC FROM WITHIN

with a problem employee short of being stuck with him. This is definitely a misconception.

The junior officer faced with this situation should immediately seek the counsel and guidance of a competent civil service representative or the civil service personnel office. Proper procedure in these matters, particularly in regard to any adverse or disciplinary action, is very important.

The officer needs to acquaint himself with the various GS grades and WG levels and understand what they mean. For example, he will want to know the level of the foremen, leadingmen, and other key blue collar workers with whom he is frequently in contact. He will want to know how the GS grades would roughly equate to an officer rank, and what grades are considered executives. Senior civilians should command the same respect from the junior officer that he would give to a senior officer.

Knowing something about the grade structure will assist him in knowing what to expect from a certain grade of employee with regard to performance, ability, education, etc. The position description may also be helpful in becoming familiar with the requirements inherent within a particular job. Senior civilians can also advise the officer of what can be expected from particular employees, and any special talents they may possess.

The techniques of supervision used to handle the average civilian is quite unlike those used with military personel. Often even senior officers have considerable difficulty in this regard.

There are some excellent short courses given by the Regional Offices for Civilian Manpower Management which help prepare the military officer for proper supervision and motivation of civilians. Officers should attend these presentations whenever possible.

An officer should become familiar with the procedures for hiring new employees. He should understand the basics of ceiling points, recruitment, advertising the job, job description, interviewing, and finally selecting an applicant. Assistance may be obtained from the local civilian personnel office in these areas, and the short courses offered by the Regional Offices of Civilian Manpower and Management are also helpful and informative.

The young officer needs to realize how he is viewed by the average civilian. The new officer will frequently find himself on the defensive for the first few months. He will have to prove himself to the civilians. The average civilian is usually willing to meet the young officer half-way in solidifying a mutually satisfying relationship.

The wise officer entering a new career in the CEC should realize that often his relationship with the civilian employees in his organization will either make or break him.

Regardless of your technical expertise, your success in the CEC will be determined in large measure, by your ability to deal with people.

The most successful CEC officers are *people oriented.*

Meeting The Nation's Environmental Goals

• Port Hueneme, Calif.

The Navy's mission to develop modern ships and weapons systems — and to train personnel to operate them — directly supports the nation's goal of a strong, national defense. Similarly, the mission of the Environmental Protection Agency and other regulatory agencies to enforce environmental laws, regulations and standards directly supports the nation's goal of improving the quality of the environment. The two national goals may be somewhat in conflict from the standpoint of practicality and simultaneous achievement.

Nonetheless, federal agencies are required by Executive Order to provide leadership in the nationwide effort to protect and enhance our environment. The orders, reinforced by Navy and Marine Corps directives, mandate cooperation with *all* enforcement agencies — federal, state, local — and compliance with their standards and criteria, including permits and consent agreements.

A standard retort when Navy money problems are cited is that "environmental enhancement is not new and neither are funding cycles." MCON, O&MN, OPN, etc., are funding symbols that have no meaning or interest to the enforcement branches of government. Because of this, the Department of Defense has "fenced" environmental funds provided by Congress and they are added to normal allocations. These funds *are not* part of the DOD operations budget.

Issuance of an air pollution consent agreement does not license an activity to operate indefinitely in "non-compliance" of legal requirements. On the contrary, enforcement agencies expect naval commands to comply with specific requirements of permits; and, the Navy's planning, programming, and budgeting system notwithstanding, aggressively to correct pollution deficiencies. If the Navy is found in violation, action will be taken including citation and court action.

Through the Naval Environment Protection Support Service (NEPSS) all Navy and Marine Corps commands get aid identifying previously unknown pollution sources, evaluating current pollution control projects to conform with existing or foreseeable standards, providing data for new pollution control projects, and in negotiating with regulatory agencies on permit conditions. It is essential, therefore, for NEPSS "customers" to know what is available to them and to know how to obtain needed service. With this goal in mind, the following information should prove useful:

• **Environmental Engineering Survey.** The NEPSS Regional Environmental Support Offices at NAVFAC Engineering Field Divisions are responsible for periodic environmental engineering surveys of all Navy and Marine Corps commands under their control. These surveys are designed to identify pollution problems *before* they become an issue with regulatory agencies and to allow preparation of Pollution Control Report exhibits.

• **Pollution Control Reports** (PCR). Once environmental deficiencies have been identified, the most rapid and efficient method to obtain correction funds is through the PCR. Perhaps the single most difficult problem faced by preparers of PCR exhibits is identification of a pollution abatement project. PCR projects *can* be compatible with operational needs. For example, the following could be considered within the scope of a PCR project to provide:

- — Fencing and lighting around fuel storage areas.
- — Replacement of leaking oil, sewage, and potable water lines.
- — Training for sewage treatment plant operators.

Naturally, each project must be judged on its own merits; however, many tangible and intangible benefits can accrue to an activity that takes time to identify "pollution abatement" as it might apply to problems at hand.

• **Legislation Review.** The Navy Environmental Support Office at Port Hueneme provides a continuing review of legislation in the Federal Register. Interesting items and their geographical area of impact are reported by NESO Information Bulletins.

If warranted, an in-depth analysis of specific regulations is made and results are distributed as NESO Regulations and Standards Reviews.

By
PHILIP
WINTERS
General Engineer, NESO

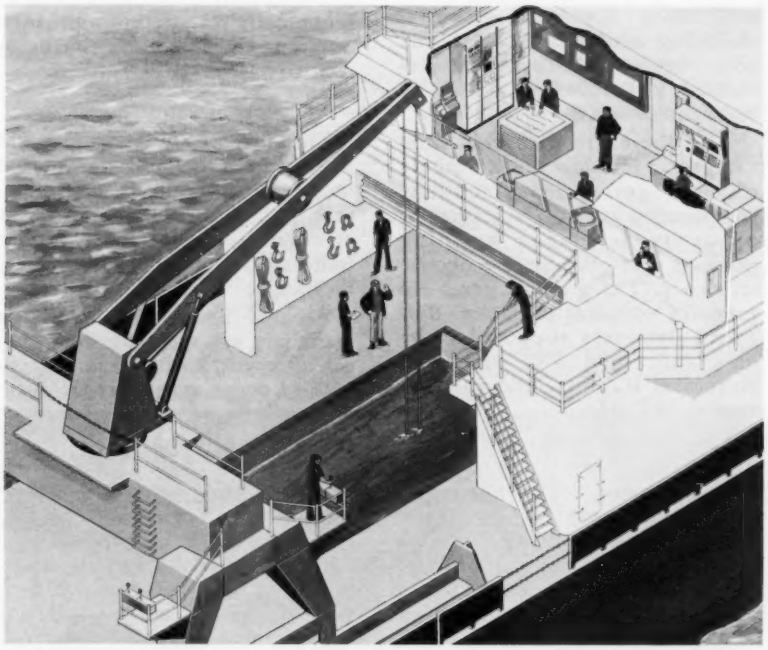
• **Specialty Team Assistance.** NESO has teams of environmental experts who can provide on-site assistance to activities experiencing pollution problems. Specifically, the NESO can:

- — Conduct source emission tests on stationary sources of air pollution to determine compliance with local regulatory agency rules and regulations.
- — Conduct ambient air studies to determine quality of the environment and to analyze the impact of Navy operated point sources.
- — Conduct special air pollution engineering studies to determine effectiveness of process controls.
- — Conduct water pollution studies involving episode situations or problems of a unique nature.
- — Provide consultation service in all aspects of environmental engineering.
- — Provide quality control services to assure that terms of NPDES permits are being met.
- — Through the Aircraft Environmental Support Office, provide acoustic experts to measure environmental noise.

It is noteworthy that services provided by the NEPSS are fully funded and require no cash outlay by the activity. Furthermore, NESO has an inquiry desk to receive calls for assistance; just dial Autovon 360-4182 and let your needs be known.

SEACON: Advanced Construction Goes To Sea

By LT TROY K. PYLES, CEC, USN
Assistant Director
Ocean Facilities Program Office
NAVFAC HQ



New mission — A former sea-going Saturn IV-B rocket-stage carrier has been modified to serve as an ocean construction platform. The 260-foot ship can support 50 people on prolonged construction projects.

• Alexandria, Va.

The Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM), will soon accept delivery of a specialized ocean construction platform.

The platform, which was altered from its previous mission as a *Saturn* IV-B rocket-stage carrier for NASA, is the first in the Navy's inventory designed specifically for ocean construction. It is 260 feet long and 48 feet wide, large enough for an adequate staging area and has an accurate positioning system for precisely placing and recovering fixed ocean facilities.

The features enable large ocean construction projects to be conducted at sea and to improve performance of waterfront construction. The platform is capable of supporting prolonged construction operations and will accommodate 50 persons selected from military and civilian personnel from the Chesapeake Division and the Naval Construction Force. Having undergone major alteration at the Norfolk Drydock and Shipyard Company, the platform has begun shakedown and training operations.

In September, the unit is scheduled to deploy to St. Croix, V.I., where, for two months, it will support the Atlantic Fleet Weapons Training Facility in repair and upgrading of an underwater tracking range.

To take note of the platform's special purpose and its new role with the Navy, CHESDIV employees were encouraged to submit appropriate names for the platform. The title of the winning entry was the SEACON, an acronym standing for "sea construction." When the platform was launched in early summer it was bearing this proud title.

Designing To Life-Time Cost

Computer-aided cost analysis techniques can produce high savings over a building's lifetime

By STEPHEN J. KIRK
Architect
Western Division, NAVFAC

• San Bruno, Calif.

Designers today are faced with myriad problems. Among them are rising construction costs, increasing environmental laws and code regulations, energy conservation measures and rising maintenance costs.

Also there are pressures from Congress for low cost, highly efficient government facilities, compounded by material shortages, or newly developed building products that offer more economic efficiency. The previous items are primarily economic in nature. But, aren't designers supposed to be only concerned with esthetics, structural stability, and environmental comfort?

The answer to this question is not new.

In his book, "The Economic Theory of Railway Location," the earliest book on engineering economy, A. M. Wellington recognized that architects and engineers must be as cognizant of economics as they are of design.

Wellington's book was written in 1877, in a time when investments in U.S. railways were greater than than aggregate of all other investments in industrial assets. Railway location is obviously a field in which many alternatives are available. Wellington observed that there was an almost complete disregard by railroad engineers of the influence of their decisions on the future costs of the railways.

To attack these and other economic problems, all the technology available to the engineer is required. During the past several months an Economic Building Performance Model (EBPM) has been used *heuristically* (as an instrument of discovery) in the quality control branch of the design division at the Western Engineering Field Division, Naval Facilities Engineering Command. This life-cycle computer model was technically evaulated and then applied to a typical bachelor enlisted quarters (BEQ) project.

Purpose and Theory

The purpose of the model was manifold. Paramount was that it must enable architects and engineers quickly to evaluate in terms of economic performance various building design alternatives over the lifetime of the facility.

Because about 90% of design manhours are spent on work that can affect cost about 7%, and about 10% of design manhours are spent on preliminary design decisions which can affect costs 30%, the model had to be developed for use in the early schematic stages of design.

This initial design becomes even more important because many buildings built today exceed their cost of construction in operating expenses in as little as three years.

The energy shortage has convinced even the most skeptical that something must be done to make our nation more energy efficient. The Navy has issued many regulations concerning its commitments to energy savings. The EBPM enables designers quickly to test various schematic building solutions so that each designer can make a more thorough evaluation of energy consumption.

The model also provides the capability of analyzing existing buildings, including various renewal proposals, in the effort to improve present naval facilities.

Another important future cost is maintenance. The Navy currently spends as much, or more, for maintaining a facility over its lifetime than it does for the initial cost of construction. With current inflation building maintenance costs will become an even more important factor. The building performance model considers maintenance costs for every design alternative created.

Replacement costs for various components within a building are very difficult to predict. A probability for the life of every building must be established to arrive at future costs. It becomes even more complicated with the unknown cost increases in labor and material.

The EBPM considers replacement costs based on average expected building performance. Several controls are provided so that the "sensitivity" of these assumptions does not "overweigh" the economic comparisons.

These items are a few of the considerations of the EBPM. In addition to future costs, the model is very helpful in determining fast initial cost studies. By assuming various typical building-component systems, the designer can quickly realize the initial cost impact on his decisions. By making design "trade-offs," certain amenities can be substituted for others in order to stay within the project budget. Every decision made in the design of a facility compromises the designer. Questions such as: should the project have a longer lasting roof system? a better quality water heater? more landscaping? or a more stimulating work area?; can be economically evaluated using the EBPM.

The final choice between design decisions is left to the designer.

Even choices between plumbing systems, available materials, and new products are much more easily made with the use of the EBPM.

Another important use of the model is in the value engineering field. One of the largest architectural firms in the United States, recently described its value engineering experience. Its approach of computerizing various building systems and applying them to various building design alternatives for the evaluation on a first cost basis is very similar to the approach taken in the EBPM.

From a value engineering standpoint this firm was looking for the least expensive construction technique to satisfy its objectives. Many statistical figures, e.g. the weight of steel per square foot of building were generated by the computer approach. These statistics are used as "red flags" to the value engineers, indicating further study is necessary in a certain area if specified limits are exceeded. The capability for this method of value engineering is present in the EBPM.

Because of the large number of problems faced by designers today, a heuristic tool has been developed. This model combines economic theory with simplistic prediction algorithms concerning initial building cost, fuel consumption, maintenance, subsystem replacements, and fire protection.

Many of the formulas are not considered to be exact in the sense that they compute the actual cost. They are instead a simplified set of relationships which will provide the user with a good approximation of actual building expenditures. The intent of these relationships is to provide the designer and the Navy with a maximum degree of economic information about various building design alternatives during early stages of design when it can be most advantageous. Because of the tremendous number of design alternatives that can be quickly analyzed, the EBPM becomes a "creativity amplifier" for the architect and engineer.

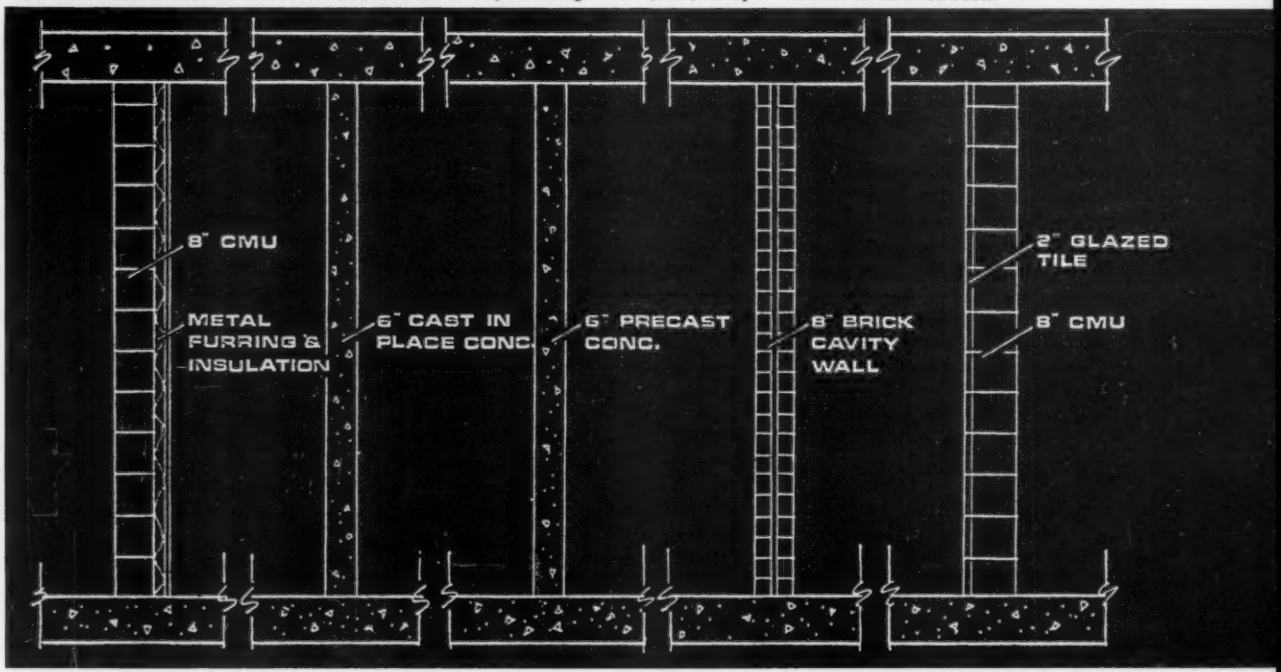
To test the features previously described, a typical project was selected for model application. For simplicity an "in-house" designed bachelor enlisted quarters (BEQ) for the Camp Pendleton Marine Corps Base in Southern California was chosen. Preliminary drawings were used to provide all the data required. The three-story facility was designed with concrete block bearing walls and cast-in-place concrete floors. At no point does the EBPM eliminate the architect and engineer from the design process. Basic parameters about the building, such as size, orientation, various climatic conditions, buildings materials (systems), etc., were abstracted from the BEQ drawings.

Computerized predictions were then made about the building's initial cost and its annual owning and operating expenses. This printout will be referred to as the "base run" (actual design of the BEQ). All other design alternatives will be compared against this base run. Any deviation will be listed in "present-worth" dollars. In this example, there were twelve "group" building categories. Cost per square foot and system percent of total building cost statistics were also provided. A cost summary, including a cost conversion to present-worth dollars, is provided for each year.

The $2,065,000 initial cost of the proposed project can be ascertained from this "life-cycle" cost summary.

(Continued on next page)

CHOICES — Typical of the decisions an architect must make designing a facility is that of exterior wall type. Various thicknesses of walls were tested using the computer model and costs compared. Of the types modeled, the CMU was cheapest and six-inch cast-in-place wall slightly more expensive. The cast-in-place wall, however, produced a life-cycle savings of $22,422, mainly in reduced maintenance costs.



(Continued from preceeding page)

The total cost of the project over its life of 25 years expressed is $4,791,000 in present worth. The predicted value of energy consumed by this design on a yearly basis amounted to 3,783 MBTU.

To illustrate the capability of the model, a series of 28 design alternatives was tested in a one-day period. The first changes dealt with rotating the building clockwise around the site. Because of the mild climate no air conditioning was provided and little savings of energy was predicted. A test was then performed to determine the effect of a double glazing system if it were substituted for single glazing. The initial cost of construction increased by $8,622.

Although this provided an energy savings of 2.5% per year, the life-cycle (discount rate of 10 % over a 25-year period) did not amortize the added expenditure. When the amount of glazing was reduced by one-half and double glazing was assumed, a net savings of $4,581 in initial building cost occurred. With this proposal, the life-cycle cost also indicated a savings of $19,263 or 0.4% in the total owning and operating cost of the building.

A packaged unit air conditioning system was then evaluated as part of the BEQ to see what effect this might have. The initial cost of the building increased by 0.7%, while at the same time, energy consumption doubled. The life-cycle cost increased by 2.2%.

Exterior wall systems were then changed to see what effect this would have on the life cycle cost. A typical wall section of the project consists of an 8" CMU wall with gypsum on metal furring and rigid insulation. Another proposal was a 6" cast-in-place concrete wall. Comparing the two, the concrete wall increased the initial building cost by only $6,322. The life-cycle cost of the building using a cast-in-place wall system was $22,422 less. These savings to the Navy are reflected primarily because there is less maintenance involved. Using a 6" precast concrete wall, cost increased by $51,463. The total cost of this proposal over its life produces a net loss of $25,238. Because this system produces a shorter construction time, the added investment could produce a life-cycle savings depending upon the worth of "time" in the construction process.

Next, an 8" brick cavity wall system was tested to see what impact this would have upon the building design. The initial building cost increased by $69,097 with the brick system. The added investment, in this case, did not provide a life-cycle savings.

The final exterior wall system to to be tested consisted of a 2" glazed structural tile with an 8" concrete block back-up. This system increased the initial building cost by $44,697. The total cost of this proposal over its life produced a net loss of $11,118.

Other engineering data were then varied within the EBPM. First it was assumed that the burning hours per year of lighting were reduced by one-half. Although the building designer has no control over this factor, it is important to test the "sensitivity" of the model. This assumption produced a life-cycle cost savings of $20,456. In addition, energy consumption was reduced by 6% per year.

The project discount rate was varied to see what impact, if any, this would have upon the project. When the rate was changed from 10 to 15%, the life-cycle cost decreased to $3,805,000. When the rate was varied downward to 5%, the corresponding life-cycle cost increased to $7,073,000. This very clearly indicated the impact of changing the discount rate (cost of money). As the rate increases, the relative importance of future dollars (owning and operating costs) decreased.

Yearly projected costs for various resources were then tested. First, the yearly heating oil cost escalation was changed from 9% per year to 4%. This produced a reduction in the predicted life-cycle cost of $18,803 or 0.3%. The heating yearly increase was then accelerated from 9% to 14% per year. This generated a life-cycle cost increase of $38,622 or 0.8%. Lighting and equipment energy yearly costs were then increased from 3% per year to 8%. The corresponding life-cycle cost rose by $138,000, almost a 3% increase in present worth dollars.

Finally, the average yearly increase for maintenance services for the proposed building was accelerated from 10% to 15%. This produced a drastic change in life-cycle costs. The maintenance change alone produced an increase of $1,667,000 or a 35% increase! This certainly suggests that more serious thought should be given to maintenance as part of initial design.

The analysis is only a sampling of the types of economic testing possible with the EBPM. The results presented here suggest that the architect and engineer must be very scrupulous in their design decisions. Only when an economic "life-cycle" evaluation is made or proposed can a true understanding be achieved.

Consequently, designers must deal effectively with overwhelming problems. These problems are economic in nature and as such, the solutions of these problems require all the technology presently available to assist the designers.

The Economic Building Performance Model (EBPM) is the first step in creating a set of design processes for a new generation of architectural design. This "new" set of design processes must fully encompass the cybernetic approach of which the building environment really consists. Economic evaluation is a well-understood beginning point in this process. Future considerations should include: Simulation of users or processes within the given design alternative, space-use efficiency calculations, form-to-function checks, structural compatibility, mechanical and plumbing layout and design efficiency, design objective solution "fit," and ultimately, user/owner design satisfaction.

Almost a century ago, Wellington stated the goal of designers best when he said:

"As the correct solution of any problem depends primarily on a true understanding of what the problem really is, and wherein lies its difficulty, we may profitably pause upon the threshold of our subject to consider first in a more general way, its real nature; the causes which impede sound practice; the conditions on which success or failure depend; the directions in which error is most to be feared."

THE HIGH-GRADE CRUNCH

excerpted from the NAVSEA News

• Alexandria, Va.

Recent restrictions on grades GS-13, 14 and 15 have had a profound impact on manpower management. Many employees don't understand these restrictions, why they have been imposed, and how they will affect future appointments. This article discusses what led to increases in high grade positions in the Navy, attempts to reverse this trend, reasons for imposing restrictions, current and anticipated practices, and outlook.

Two conditions existed between 1955 and 1965. First, was a substantial difference between the General Schedule salary structure and pay in the private sector for similar work. General Schedule pay adjustments occurred only every three or four years and, when they were made, were based on data a year old or more.

Second, there was an "expansionist" atmosphere in hiring technical and managerial talent, both in government and the private sector. Salary level was not one of the advantages of federal service during that period. People could — and many did — leave federal service for higher pay in the private sector for essentially similar work.

Managers and personnel staffs responded to this with aggressive college recruitment programs; dynamic formal training programs, both to get newly hired "up to speed" quickly, and to provide accelerated promotion; salary structures above the normal General Schedule for certain occupations; rapidly processed personnel actions to "save" employees for the agency; and liberal interpretation of position classification standards.

"Job engineering" or "fragmentation" became common. By allocating higher grade level duties among a number of positions, rather than concentrating them in fewer positions, a structure could be established which supported more positions at the higher grade.

"Layering" also became common. By structuring supervisory positions over a relatively small number of subordinates rather than concentrating control, more high grade supervisory positions would be created.

Over time, these actions were viewed as acceptable management techniques and resulted in some incorrect attitudes. First, there was a widespread opinion that the "journeyman" or full-performance level, i.e., the grade of non-supervisory work fully representative of the occupation, of professional positions, was GS-13, perhaps GS-14 in the Washington area, and maybe a grade lower in the field.

Second, while promotion to or toward a full-performance level on the annual eligibility date is the normal course, many people wrongly considered it a routine entitlement. Finally, hardly a day passed that a manager didn't visit his personnel office with a proposal to promote an employee because that employee had applied for a promotion elsewhere and was likely to be selected.

In short, while such practices and attitudes were formed between 1955 and 1965, and were responsive to needs then; many have been carried over to 1976, which is quite a different matter.

In the late 1960s, things began to change. The employment market stabilized, the Civil Service Commission cancelled many advanced salary rates, and pay adjustments came more frequently and were closer to comparability with the private sector. However, the rise in high grade structures continued.

In 1964, the Office of Management and Budget — then the Bureau of the Budget — issued guidance on position management to structure organizations conservatively regarding manpower and grade level. The Navy also issued instructions, but average grades continued to rise. In 1969, the Navy strengthened its guidance, allowing wide flexibility to do sensible things while trying to turn grade creep around.

In 1971, a review of Navy-wide progress regarding position management disclosed a disturbing fact: in the three years ending June 30, 1971, General Schedule population declined by more than 12,400 while those at GS-11 and higher increased by more than 6,000!

In the three years ending June 30, 1974, the following changes occurred:

	Navy	Army	Air Force
GS Population	-4,878	-6,000	-6,437
GS-13	+ 195	-1,432	- 813
GS-14	+ 153	- 667	- 258
GS-15	+ 8	- 285	- 177

A study by the Office of the Secretary of Defense indicated professional, administrative and clerical salaries in private industry rose 56 percent from 1962 to 1972, while GS salaries rose 100 percent during the same period. These hard data focused high level attention on the cost of continuing the present high grade structure within government and Navy.

The Navy responded to this situation by attempting to explain its high grade structure. For example, the Navy has more formally designated "major programs" than either of the other services. Foreign military sales administered by Navy have greatly increased.

While the Army and Air Force staff their laboratories liberally with military personnel (17 percent and 43 percent respectively), the comparable figure is under 8 percent for Navy. With comparable military staffing, the Navy would have fewer high grade positions. In the past decade civilian substitution of military personnel has swelled the Navy's high grade ranks.

Selective conversion of Wage Board supervisors, especially shop superintendents to General Schedule grades has done likewise. The increasing technological complexity of current and future Navy project systems is also reflected in the grade structure.

Despite all efforts to explain the situation and obtain some relief, management efforts to cut high grade positions have been directed.

Because exhortations hadn't worked, high grade targets (or allowances) were promulgated in November

1974 for FY75-76. The decline in numbers of high grade personnel in the next four months was so slight as to cause a freeze on filling high grade positions throughout the Naval Material Command. NavMat has more than 75 percent of the Navy's high grade positions. That freeze has continued in one form or another since March 1, 1975.

Assigned targets were less than the high grade employee populations for every component of Naval Material Command. The NAVFAC high grade *requirement* consists of people on the rolls, valid but vacant positions, and requirements for new programs. But our target wasn't enough to cover even high graded people on NAVFAC rolls. Initial NAVFAC allocations were then made based on on-board population, assuming the proportion of vacancies was about the same for all components. Progress, to this date, is as follows: on-board 12/31/74 — 1,158; on-board 4/30/76 — 1,067; target 6/30/76 — 1,060; target 9/30/77 — 1,043.

On July 1, 1975, for the first time since passage of the Position Classification Act of 1949, position classification authority for GS-15 positions was withdrawn from all navy components and centralized in the Office of Civilian Manpower Management.

Also, Naval Material Command revised its organization guidelines to require a minimum of four subordinates (excluding clerical) to support supervisory positions, and a minimum of six where deputies to the supervisor are absolutely necessary (but deputy positions are actively discouraged).

As this article is written (June, 1976), the current modified high grade freeze allows replacement of one high grade employee for every four who leave NAVFAC rolls. As is evident, NAVFAC has almost achieved its FY 76 target. It is hoped when the target is reached, NAVFAC will be able to form a more orderly management program.

For the past several months, requests to fill critical high grade vacancies and promote to the GS-13/14/15 level have been submitted to NAVFAC HQ. A priority sequence based on supporting documentation, has then been provided to the Headquarters Command Advisory Board (CAB) for review and recommendation to the Commander NAVFAC for the most critical positions.
In the past year, some 200 high grade requirement requests have been processed. Of these, 61 positions were filled. Not all of these actions increased NAVFAC's total of high grade positions since a few were within the high grade range, e.g., GS-13 to GS-14.

While FY75-76 targets were established for all NAVFAC components, final FY77 targets have not yet been allocated.

It is expected that sometime between July 1-September 30, 1976, NAVFAC activities will return to managing their own high grade resources within the targets assigned. Great care must be exercised allocating high grade positions. The high grade situation does not mean promotion opportunity has ceased because the Command has a number of critical, unmet high grade requirements.

It does mean, for the near term, increased emphasis must be placed on meeting requirements from within NAVFAC resources, preferably by lateral reassignment from lower priority jobs: and that some positions, when vacated, will be restructured to lower grades or abolished. Command-wide, we will be restructuring organizations to meet reduced high-grade allowances.

With that accomplished, positions may be filled normally. Meeting our goals will necessarily eliminate some high grade positions of lesser value.

More high grade positions may be filled by reassignment at the same grade level, rather than advertising a vacancy and promoting employees whose assignments or programs have matured and are declining.

Supervisors at all levels must pay attention to position management; to structure organizations to do things that need doing. Organizations must be conservatively structured regarding grade level, and must end tasks that cannot be justified under austere conditions.

The message to staff personnel is equally clear: strictly apply the principles of organization analysis and position classification.

Many employees are concerned about promotion opportunity to GS-13 non-supervisory jobs. A full performance level of GS-13 must usually be based on specialized expertise in a facet of the professional field. Also, it is unrealistic to expect routine progression to GS-13 in minimum time in grade. This is not to say that this will never happen, however.

The point is that reaching GS-13 in a non-supervisory position not requiring specialization, under average performance and at minimum time in grade should not be the expectation, as a general rule.

However, where full-performance GS-13 work exists, it will continue. In some such situations, though, "job fractionation" may have resulted in GS-13 work being allocated to nearly all positions, along with other duties of lower level. Proper action will be to purify positions to concentrate the higher graded duties in fewer positions.

Another issue of great concern is the possibility employees will be downgraded as a result of current high grade reviews. It is still the policy of NAVFAC that downgrading of employees, rather than downgrading positions which become vacant, is to be avoided. Preferred actions are to reassign personnel to positions which solidly support their grades and to downgrade or abolish positions only when vacated.

Indications are the high grade issue will not soon disappear. Congressional and Department of Defense interest in the use and numbers of high grade positions remains high. The subject is one of six items in a forthcoming conference sponsored by the Office of the Secretary of Defense. The Navy Secretarial level reflects continuing concern about meeting target reductions and preventing return to an unacceptably large number of high grade positions.

Most important, while the transition from liberal organization design and position classification to one more conservative may burden some, the result will be a streamlined command structure, occupied by those whose responsibilities are commensurate with grade. It is NAVFAC's responsibility to ensure this objective is met without inviting application of more external pressures.

Naval Facilities Engineering Command
SITUATION REPORT

PCB'S DAYS ARE NUMBERED - Polychlorinated biphenyls (PCB's) are a highly toxic family of synthetic chlorinated organic compounds. They are used primarily in transformers and capacitors as a coolant due to their dielectric properties, chemical stability, and fire resistance. PCB's are acutely and chronically toxic, and rapidly concentrate (bioaccumulate) from water to aquatic invertebrates, fish and mammals. The new Toxic Substances Control Act requires a phase-out of PCB use in the United States. Monsanto Co., the sole manufacturer of PCB's in the United States, has indicated that it will cease all domestic manufacture by 31 October 1977 and end all sales when inventories are depleted. (NAVFAC Code 10)

NATIONAL DRINKING WATER STANDARDS - The National Interim Primary Drinking Water Standards (40 CFR 141) become effective in June 1977. The standards set maximum contaminant levels for organic and inorganic chemicals, turbidity, coliform bacteria, and radionuclides. The major requirements are: periodic water testing by state certified labs, reporting results to state, and public notification if maximum contaminant levels are exceeded. BUMED and NAVFAC instructions will be issued in the near future to implement the standards. These requirements will impact on activity budgets and responsible Public Works officials should check 40 CFR, Section 141.3 to determine if their potable water systems are subject to the standards. The cognizant NAVFAC Engineering Field Divisions are available to provide technical assistance upon request. (NAVFAC Code 10)

OIL SPILL CONTROL MANUAL - A comprehensive manual for oil spill control in inland waters and harbors is nearing completion. It covers policy, rules, regulations, and procedures for prevention of oil spills as well as information on containment, removal, and disposal of spilled oil. The manual will be distributed during the third quarter of FY77. (NAVFAC Code 10)

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Naval Facilities Engineering Command

SITUATION REPORT

MAINTENANCE SERVICE GUIDE SPECIFICATIONS - NAVFAC, in cooperation with the EFDs, has prepared a series of guide specifications to promote uniformity in specifications for service type contracts. The specifications are amalgams of possibly the best features of specifications written within the government in the past. They can be of great help to the average activity Public Works Officer in that he does not have to reinvent the wheel each time he wants to procure routine services by contract. The specs may be used in whole or in part.

The standard clause package (boiler plate) to be used with the specifications is being revised in-house and will be distributed when completed.

The following specs will be available in approximately 60 days from the Naval Publications and Forms Center, Philadelphia: Airfield Lighting Systems, Street and Perimeter Lighting Systems, Airfield Pavement Patching, Elevator Maintenance, Maintenance of Roads and Shoulders, Grounds Maintenance, Pest Control, and Glass Cleaning. Copies of these type specs have been distributed to major claimants and EFDs. Activities that have a requirement may obtain copies from either of these sources pending their availability at the Naval Publications and Forms Center, Philadelphia.

(NAVFAC Code 10)

THE DOD PEST MANAGEMENT PLAN - reemphasizes requirements to: (1) train and certify all personnel who use or supervise the use of pesticides (insecticides, rodenticides, herbicides and many others); (2) maintain records, and (3) suspend certification of applicators who misuse pesticides. The DOD plan has been approved by George Marienthal (DASD - Safety and Environment) and has been informally approved by EPA. The plan will be forwarded to the states for comment in the near future. DOD intends to continue to certify its own personnel rather than rely on the fifty different state plans unless specific state laws prohibit reciprocity. For Navy personnel, this will mean two things: (a) initially, pesticide applicators will be trained in a three to four week course by the Bureau of Medicine and Surgery and (b) the required recertification will be conducted by EFD entomologists, most likely on a three year cycle.

(NAVFAC Code 10)

TECHNICAL NOTES

Wastewater analysis demands attention to error possibility

Many of the chemical parameters of common interest in the water and wastewater field may be quantified by colorimetry. For example, chlorine, ammonia, fluoride, phosphate, sulfate, and pH can readily be measured colorimetrically. Also, several metals can be quantified in water in this manner.

The accuracy of the technique, however, has several limitations; one of the most subtle of which is the basic relationship between light incident to and transmitted by a solution.

Colorimetry is an analytical technique using the relationship between absorbed monochromatic light and solution concentration. Since the absorbance — or optical density — of a solution is proportional to the concentration of a monochromatic-light-absorbing parameter, a photocell can be used to quantify the parameter.

The procedure is basically one of converting the chemical species in question to a color-producing solution or suspension. The intensity of the color, then, is directly proportional to the concentration of the species originally present. In ammonia determination by Nesslerization, Nessler's reagent combines with ammonia in an alkaline solution to produce a yellowish-brown colloidal suspension. The reaction is represented by the equation:

1.

$$2K_2HgI_4 + NH_3 + 3KOH \rightarrow Hg\begin{matrix} \diagup I \\ \diagdown O \end{matrix} + 7KI + 2H_2O$$
$$Hg \diagup \diagdown NH_2$$

(Yellow-brown colloid)

While the absorbance of the solution is directly proportional to the concentration of the species in question, the photocell in a photometer or spectrometer measures the **intensity** of light transmitted, which isn't directly proportional to concentration.

Beer's Law is the "jumping off point" in this discussion. Basically the law says the intensity of monochromatic light decreases exponentially as it passes through a solution or medium of light absorbing matter. Mathematically, it is more simply stated:

2. $$T = \frac{I}{I_0} = 10^{-kc}$$

or

3. $$A = \log \frac{I_0}{I} = kc$$

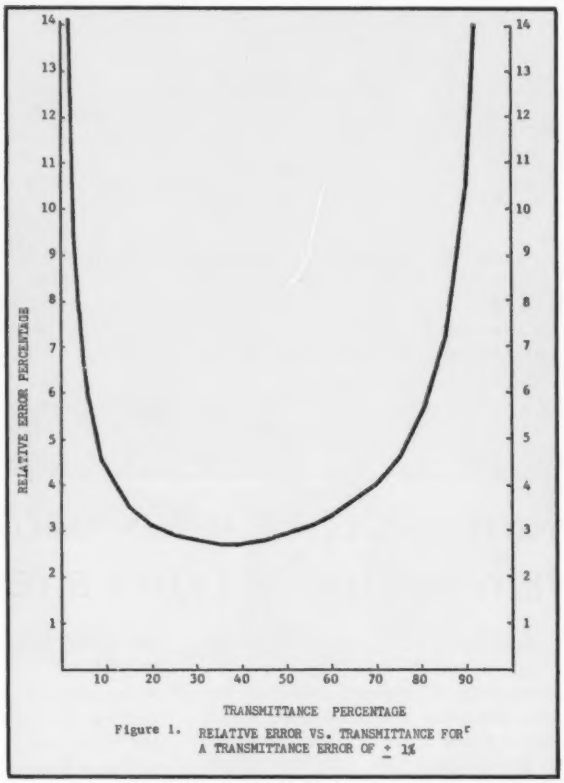


Figure 1. RELATIVE ERROR VS. TRANSMITTANCE FOR A TRANSMITTANCE ERROR OF ± 1%

where I_0 = intensity of influent light, I = intensity of effluent light, T = transmittance, or fraction of incident intensity that leaves solution, A = absorbance, k = proportionality constant for particular solution, c = concentration of parameter in question.

Equation 2 shows the exponentially decreasing relationship between light passing through the solution and solution concentration. A small error in measuring light intensity will not necessarily generate only a corresponding small error in the concentration determination. Consider the following:

4. $$A = \log \frac{I_0}{I} \;\&\; \frac{I_0}{I} = \frac{1}{T}$$

so $$A = \log \frac{1}{T} = -\log T$$

and $$A = -0.434 \ln T$$

Differentiating with respect to T gives

Continued From Preceding Page

PUBLIC WORKS TECHNICAL NOTES

(Cont'd from preceding page)

$$\frac{dA}{dT} = -0.434\left(\frac{1}{T}\right)$$

and dividing both sides by A we get

$$\frac{dA}{A} = \frac{-0.434}{-T \log T} \cdot dT$$

or, by approximation

$$\frac{\Delta A}{A} = \frac{0.434}{T \log T} T$$

Thus, with equation 4, the range of relative error in concentration can be plotted versus, say 1% error in transmittance. So, for example, at 80% transmittance a 1% error in transmittance measurement would mean the concentration confidence interval would be

$$\frac{\Delta A}{A} = \pm \frac{0.434 \times 0.01}{.8 \times \log (.8)} \times 100 = \pm 5.6\%$$

Accordingly, Figure 1 shows graphically the variation of relative concentration error with respect to transmittance error.

The curve in Figure 1 is its important feature. The plateau shows that the minimum relative concentration error occurs near the middle of the transmittance range. At either very high or very low percent transmittances, the relative concentration error increases rapidly. This is the basis for the caveat in *Standard Methods for the Examination of Water and Wastewater* recommending only transmittances between about 10% and 80% be used for best accuracy.

Figure 1 is plotted for a 1% error in transmittance. From equation 4 it is obvious transmittance errors of greater or less magnitude will not affect the shape of the curve, only push it up or down on the graph.

Thus, in the above example, with a 2% error in 80% transmittance the confidence interval for relative concentration error would be ±11.2%. For minimum relative error, then, the analyst should set up the dilutions for a particular determination to insure the transmittance reads between 10% and 80%.

Additional information is available from Lt Tom Hagge, SouthDiv NAVFAC, Autovon 794-4770.

Jump-starting weak batteries may give hard-charging types a real jolt!

Booster-starting any equipment with a weak battery can be dangerous. Run-down batteries are also normally low on water, which allows extra space for hydrogen gas to be trapped. The slightest spark around a battery can cause an explosion. Therefore, for your own personal safety, you should always wear protection for your hands and eyes when jump-starting.

To minimize the explosion danger follow these safety steps:

- Remove all cell caps from *both* batteries. Leave them off during the process to ensure the hydrogen gas can vent.
- Connect one cable to the ungrounded terminal of the weak battery.
- Keep other end of cable from touching either machine until connected to the terminal of the same polarity on the stronger battery. (Positive to positive or negative to negative.)
- Connect the second cable to the other terminal of the stronger battery.
- Important final step: *Do not* connect the remaining cable end to the weak battery. Connect it to the vehicle frame or starter ground *below* the level of the weak battery. This eliminates the risk of sparks.
- To further minimize explosion danger, cover each battery with a piece of carpet or other heavy material.

Additional information may be obtained from G. L. Olson, Code 15312 (CESO Maintenance Bulletin 20), Civil Engineer Support Office, Port Hueneme, CA 93043, Autovon 360-4627.

Manual published; gives Navy a 'paint' expression

Change 1 to MO-110, Paints and Protective Coatings Manual, has been printed and distributed.

MO-110 is monitored by a tri-service (Army-Navy-Air Force) committee in cooperation with the National Bureau of Standards. The manual has been updated to include recently developed materials, paint systems, safety procedures and the latest federal or military specifications. Notable changes include:

- New exterior latex paints.
- Restrictions imposed by law on the use of lead-containing paints.
- Rewrite of the safety chapter to comply with OSHA regulations, provisions on how to obtain detailed meteorological information, a table of estimated film thickness of paint coatings for exterior steel surfaces.

Additional information may be obtained from H. Lasser, Code 0454B, NAVFAC HQ, Autovon 221-0464.

Continued On Following Page

PUBLIC WORKS TECHNICAL NOTES

Octane ratings changed

Octane ratings are the principal measure of gasoline quality. They indicate the ability of gasoline to prevent knocking in the engine. There are two methods of determining octane rating: "research" and "motor."

The method used in most automotive owners' manuals is the research method. But the Federal Energy Administration has chosen to allow gasoline retailers to use an average of the two different methods. This results in a rating which is approximately four points below the research rating.

This has caused many motorists to buy higher octane gasoline than their cars really need. Since 1971, almost all new cars have had engines designed to operate efficiently on sub-regular gasolines. This type gasoline averages about 91 octane by the research method but is listed as only 87 at many fuel pumps that are averaging the two methods. Extra octane is simply wasted along with its extra cost.

To find out if you are buying excessive octane, try a lower grade and see if your engine pings. If not, your savings have begun.

Additional information may be obtained from G. L. Olson, Code 15312 (CESO Maintenance Bulletin 20), Civil Engineer Support Office, Port Hueneme, CA 93043, Autovon 360-4627.

Making the grade — the Navy Civil Engineering Laboratory has developed a novel — and low cost — method of speeding ground levelling projects. Rather than conventional grade stakes, (upper photograph) the new device uses a laser-guided automatic blade control. The automatic blade control requires one less operator and no guard or grade stakes.

Conversion manual for metrics

The Naval Education and Training Program Development Center in Pensacola, Fla., has developed a manual on the metric system and how to convert to it from the British system of weights and measures.

The training manual, The Metric System (NAVEDTRA 475-01-00-75) and its accompanying two-assignment correspondence course, contains a brief history of measurement systems and discusses units of length, area, volume, weight and temperature. Formulas for converting from one system to the other are presented in an easy-to-use table.

The booklet and correspondence course is in the process of distribution and also will be available through the supply system at Philadelphia, Pa. The stock number is 0507-LP-475-0000.

SouthDiv gives pigeons the bird

By M. P. MARKS
Entomologist,
South Div NAVFAC

Many naval activities agree birds are one of the most annoying pests. Buildings are defaced and deteriorated by bird droppings, equipment and supplies are damaged, and decks, metal ladders, cranes, and other facilities are contaminated with droppings making them slippery and hazardous when wet. Cleaning up after birds is costly.

Birds also affect the health and well-being of personnel. A number of serious diseases associated with feral birds infect man and other animals, including toxoplasmosis, cocidiosis, salmonellosis, psittacosis, histoplasmosis, cryptoccosis, and Newcastle disease.

Parasites associated with nesting birds often invade buildings and become a source of human irritation.

Many devices and chemicals are sold for bird control. Firms selling these materials usually claim their product will provide a simple solution to bird problems. Some naval activities have spent thousands of dollars for mechanical or chemical bird repellents. In most cases, these products are either completely ineffective or effective only briefly.

Naval activities all over the world report sporadic results with products designed to intoxicate, electrocute, scare, shoo, blow, shoot or scream their bird problems away.

The Charleston Naval Shipyard recently asked this office to assist them with a pigeon problem they felt was getting out of hand. A survey indicated they did indeed have a problem. No less than a dozen buildings were infested with feral pigeons.

Bird control is, by nature, dictated by the situation. All available bird control techniques were considered before a decision was made as to what approach was best for the Charleston Naval Shipyard. Mechanical frightening devices such as flashing lights had been tried with little success. Shooting had proven successful with small flocks but was deemed impractical for large scale operations.

Available poison bait materials (strychnine treated bait) were known to be effective; but a mass killing of birds was considered undesirable. The command was understandably concerned that birds might suddenly start dropping dead in backyards and streets in the surrounding area.

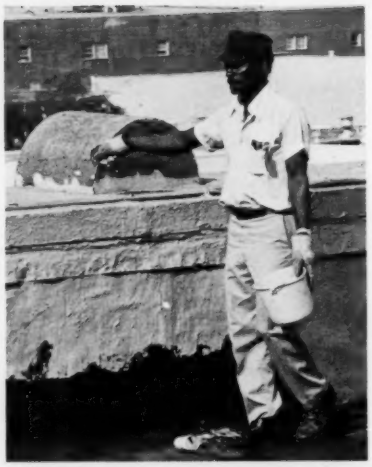
Trapping was rejected because of the excessive labor to maintain the traps. Another limiting factor was finding a humane means of disposing of trapped birds.

After all options were considered, it was decided, wherever possible, pigeon proofing material (hardware cloth and chicken wire) would be placed over potential roosting areas. It was felt that, because of its permanency, pigeon proofing would be the most cost-effective approach.

Where exclusion (pigeon proofing) was impractical, population reduction techniques would be used. This would include destroying nests accessible by a ladder or "cherry picker." Where nesting sites were inaccessible, a repellent bait was used.

This bait works by producing an alarm reaction in birds that feed upon it, thereby causing the flock to leave and avoid the area. The birds usually don't ingest a lethal dose of the bait material.

For example, a recent baiting operation dispersed a flock of fifty pigeons and killed only four. A whole-corn bait formulation is used for pigeon control. The whole-corn kernels are too large for smaller, grain-eating song birds.



Pigeon bait — A worker spreads bait in likely roosting areas. The bait causes an alarm reaction in pigeons and drives them away. Bait is too large to be eaten by smaller songbirds.

Experience gained thus far indicates any flat roof at or near roosting sites presents the best area for pigeon baiting. These locations allow feeding without the disturbance of normal traffic in the area.

To date, the Naval Shipyard pigeon control program has proven quite successful. This particular program may not work at all naval activities. Each activity must adapt to its own set of circumstances.

Plastic-lined pipes tested

The Civil Engineering Laboratory has investigated plastic-coated pipes for utility lines on Navy fuel piers. The utility lines include electrical (telephone, lighting and fire alarm), water (fire main), aviation fuel (AVGAS) and fuel oil. The different lines were field tested from 40 to 61 months.

It was found that poly vinyl chloride-jacketed galvanized steel conduit and fittings should be used in place of galvanized steel conduit for under-pier electrical utility service. Polyethelyne-jacketed steel pipe should be used in place of tar- or felt-covered steel pipe for fire mains and fuel lines. Both the above materials are recommended for replacement of existing lines as well as for new construction.

When existing lines are to be cleaned and restored, Techdata Sheet 75-26 should be consulted for recommended coatings and coverings.

Additional information may be obtained from T. Roe, Jr., and R. Alumbaugh, Code L52, Civil Engineering Laboratory, Autovon 360-4772 or 360-4679.

OUR READERS RESPOND

Kudos for the Underground

Dear Sir:

Your article, "Thinking down through earth . . .," in your Spring 1976 issue is one of the finest, most difinitive, "depth" studies we've seen on the subject of building underground. And all on five pages, too, as opposed to 540 in the conference reprints . . . of the best minds on the subject.

Shirley Boyce
Managing Editor
Buildings — The Construction and Building Management Journal
Cedar Rapids, Iowa

Dear Sir:

I was interested to read the article "Thinking Down Through Earth", by Lloyd S. Jones, LCDR, CEC, USN, in the Spring, 1976, issue of "The Navy Civil Engineer", and also your comments concerning underground location of nuclear power units. This option has been seriously advocated in a report by Watson, Kammer, et al of the Environmental Quality Laboratory of The California Institute of Technology. Underground nuclear power units are, I understand, in use or being considered in Europe. Also, Dr. Edward Teller has been reported as saying that no nuclear power plants should be constructed unless they are constructed underground.

The potential of underground space for helping to solve a variety of pressing technical, social, and environmental problems is beginning to receive some recognition, and I congratulate the Editors of The Navy Civil Engineer for drawing attention to it both by the articles of LT Lloyd Harrison and LCDR Lloyd S. Jones, and your editorial.

Yours sincerely,

Charles Fairhurst, President
American Underground Association
Minneapolis, Minn.

Dear Sir:

At your convenience, I would appreciate information as to how I might obtain a copy of the Summer 1976 issue of NAVY CIVIL ENGINEER. I teach a course in the History of Engineering and Technology and I would very much like a copy of this issue for my files. The historical information is of much interest and would be valuable for this coursework.

J. Paul Hartman, Ph.D., P.E.
Chairman, Civil Engineering and Environmental Sciences
Orlando, Florida

Dear Sir:

I found your summer, 1976, issue of THE NAVY CIVIL ENGINEER quite interesting. One of the most interesting parts of the issue relates to a failure of the Pearl Harbor Dry Dock in 1913 . . .

The reason for this special interest is that I am teaching for the second time in January, 1977, a course on failures of civil engineering projects. This is the first case which has come to my attention concerning a failure of a major dry dock. It is our contention that a great deal can be learned from those projects which involved problems. Therefore, if at all possible, I would very much appreciate obtaining more complete information on the failure of this dry dock.

Eugene Chesson, Jr.
Professor, College of Engineering
University of Delaware
Newark, Delaware

Your magazine is the single most important source of information on the CEC and the best recruiting aid we have in the field.

Thanx for including us.

Dick Sim
LT, USN
Navy Recruiting District
San Antonio, Texas

Sea(bee) Stories

An Enterprising Tale

By LCDR P. F. JACOBS, CEC, USN

A visitor to the Naval Support Facility, Cam Rahn Bay, (circa 1966-71) bought popcorn at the movies, and may have bought it from CBMU 302, the exclusive agent for this rare and delicious commodity.

The Seabee's exclusive franchise was seriously challenged once, however, by the Base Special Services, who attacked with a 10c price cut and free milk shakes. The advantage was multiplied by the fact that those waiting in line could see the movie screen.

The Seabee customers had to wait behind the screen. When the Seabee's popcorn-manager asked the XO if he could put a "fix" on the competition, he was told that competition and free enterprise were the basis of the American Way and that he should use his ingenuity. The popcorn manager's only request was to work two extra hours each night in exchange for a three hour lunch break. The request was granted.

Three weeks later, the competitor went out of the popcorn business. Suspecting something other than "free enterprise," the XO held another interview. The popcorn manager advised the XO that the base popcorn line was so long, people got tired of waiting and switched to the Seabee line: "We can serve them five times as fast, sir."

"How can that be?" asked the XO. "Our machine is the same size as theirs."

The confession was forthcoming: "I pop most of it during the noon-hour."

"Nobody can sell cold popcorn!" protested the XO.

"It isn't all cold," said the popcorn manager. "We can make enough to put 2 inches of hot stuff on the top of each bag. By the time they eat that far down, they never notice the rest is cold."

COLLEGE PROGRAM

In 1961, the Chief of Civil Engineers, U.S. Navy, initiated the CEC College Program, a public affairs presentation designed to provide for the exchange of professional knowledge and to promote the profession of engineering; to emphasize the engineering and professional competence of the Civil Engineer Corps and to acquaint engineering students with the Corps and the career opportunities it offers.

The program reached 8,158 students in 207 presentations at leading colleges and universities during Fiscal Year 1976.

A typical presentation lasts from 30 to 40 minutes with between a half hour and 20 minutes open afterwards for a question and answer period. An informative and illustrated brochure concerning the presentation is available.

Persons interested in scheduling a presentation by a Civil Engineer Corps Officer are invited to contact one of the regional College Program officers listed below:

Young persons interested in a Navy career with the Civil Engineer Corps should contact their local Navy recruiter for details. If desired, the recruiter can arrange for a personal and informal 'rap' session with a Civil Engineers Corps officer through one of the officers listed.

No obligation, of course.

NAME & ADDRESS	MAILING ADDRESS
CDR Dwain Reeves (215) 775-4821 Autovon 443-4821	Northern Division Naval Facilities Engineering Command Philadelphia, Pa. 19112
LCDR John Kintz (904) 452-2275 Autovon 922-2275	Public Works Center Naval Air Station Bldg 1 Pensacola, Fla. 32508
LT John Collins (703) 444-7313 Autovon 690-7313	Atlantic Division Naval Facilities Engineering Command Norfolk, Va. 23511
LT Jerry Nibert (415) 871-2549 Autovon 859-2549	Western Division Naval Facilities Engineering Command San Bruno, Calif. 94006
LT Dennis Plockmeyer (312) 688-4950 Autovon 792-4950	NorthDiv NAVFAC Contracts Bldg 1A Great Lakes, Ill. 60088
LT Mike Soyka (401) 841-2544 Autovon 948-2544	NorthDiv NAVFAC Contracts Naval Base Newport, R.I. 02840

An invitation to young graduate engineers to join the young professionals of the U.S. Navy

CIVIL ENGINEER CORPS

Construction and maintenance of the Navy's shore and support installations is just one of the responsibilities of the engineer managers of the Navy's Civil Engineer Corps. And qualification is not limited to the civil engineering discipline, as the Corps requires graduate engineers of mechanical, chemical, electrical, industrial and construction disciplines and architecture too! As a commissioned officer of the U.S. Navy the young engineer is offered greater opportunity to develop quickly a professional career with the added potentialities of an exciting overseas assignment, professional registration and graduate studies! The young officer may be assigned to construction contract administration, public works management or with a Naval Mobile Construction Battalion, the historic Seabees, plus many individual and unique positions.

Engineering students and counselors are invited to explore the multifaceted world of the Navy's Civil Engineer Corps by contacting their local Navy Recruiter for specific details. An informal visit with a Civil Engineer Corps officer to discuss the personal and professional benefits of a Navy career can be arranged by the same Navy recruiter or by calling or writing the Naval Facilities Engineering Command, (ATTN Code 09MA1), 200 Stovall Street, Alexandria, Va., 22332 Telephone: (202) 695-3635.

Call toll-free 800-841-8000 now if you desire instant information from the Naval Recruiting Command. If you're a good student, and want to be a better engineer, the chances are you'll do best by investigating the Civil Engineer Corps of the U.S. Navy.

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